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NEWSLETTER

CLOVERS AND SPECIAL PURPOSE LEGUMES RESEARCH

Vol. 3--1969

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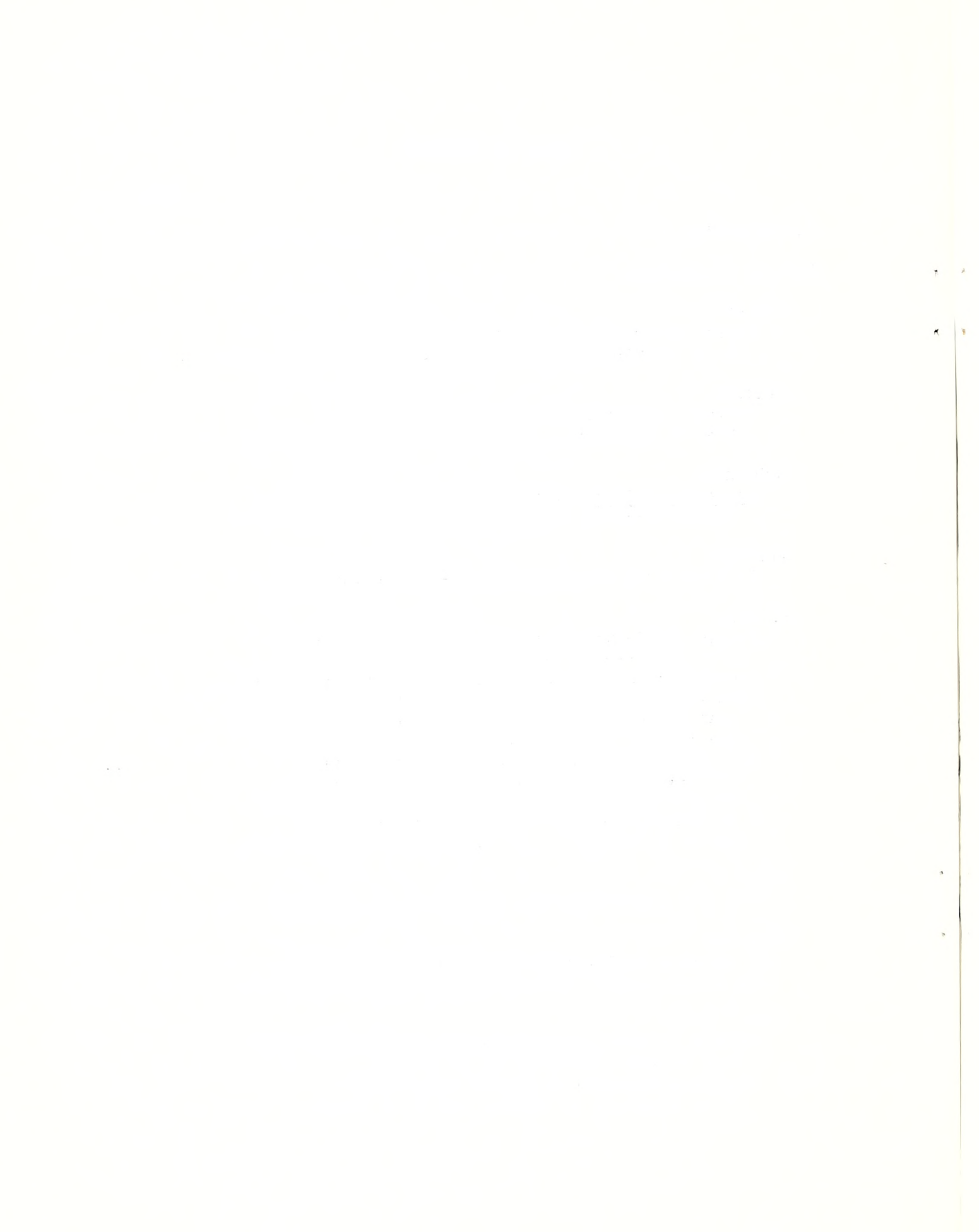
Compiled by the Forage and Range Research Branch
Crops Research Division, Agricultural Research Service
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INTRODUCTION

The objective of the NEWSLETTER -- Clovers and Special Purpose Legumes Research -- is the informal exchange of research information on the many species of forage legumes other than alfalfa. In scope, the Newsletter includes research information on the adaptation, breeding, management, and seed production of these legumes.

The contents of each volume include voluntary contributions compiled without editing. We encourage the use of this medium for the exchange of research information not available via other media. We hope the Newsletter will serve to disseminate current research information until research conferences can again be held on the main species involved. In this spirit we solicit progress reviews of your research programs on the species with which you work.

We welcome contributions and suggestions in future issues of the Newsletter.

Reports and other information for the next issue may be sent to:

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Beltsville, Maryland 20705

CANADA

Report on Birdsfoot Trefoil Strain Trials

B. E. Twamley (Guelph, Ontario)

Location: Ontario Agricultural College, Guelph, OntarioEstablishment: 1967, generally very goodSoil Type: clay loam, tile drained in 1966Fertilizer: 500 lb. of 5-20-20, and twice again in 1968Topography: gently sloping land with some replications on low groundCutting Management, 1968:

The early strains of the hay test were cut at a 2- to 3-inch stubble level on June 13, July 25, and at a 4- to 5-inch level on September 4. The later strains (Leo, SV Leo, Iowa 3019, Empire, Wallace, N6-128, MCH, P 15456) were cut at corresponding heights on June 20, July 31, and September 4. The pasture test was harvested at a 3- to 4-inch level on June 13, July 17, and August 26.

Fall recovery was adequate in all instances. The late-cut types (Leo, etc.) consistently outyielded the early types in 1968. (See 1968 copy of Forage Crop Investigations for Ontario.)

In February 1969, our snow cover disappeared and was never regained. In May, winter damage was assessed.

HAY TEST -- MORTALITY PERCENTAGE

| <u>0-5%</u> | <u>5-10%</u> | <u>15-20%</u> | <u>20-25%</u> | <u>25-30%</u> | <u>Over 50%</u> |
|-------------|--------------|---------------|---------------|---------------|-----------------|
| Leo | MCH | Viking | V5 | | Va-4 |
| SV-Leo | Royal | V2 | | V1 | Va-6 |
| Empire | C1 | V3 | | | |
| Iowa 3019 | Wallace | V7 | | | |
| | N6-128 | V15 | | | |
| | P 15456 | | | | |

PASTURE TEST -- MORTALITY PERCENTAGE

| <u>0.5%</u> | <u>5-10%</u> | <u>10-15%</u> | <u>16-25%</u> | <u>35-40%</u> |
|-------------|---------------|------------------------------|-------------------|-----------------|
| Leo | N6-128 MCH | Empire P 15456 Wallace | Dawn Westriver | Royal Viking |

Comments on Survival:

The hay test, located on slightly higher ground, showed somewhat better survival. To what extent the poorer survival in the pasture test was due to the cutting schedule or to the drainage situation is uncertain.

General Comments on Performance:

Of the early strains, four of the Cornell entries were equivalent in hardiness to Viking, and two were moderately inferior. The Virginia strains suffered heavy winter damage. None of these yielded as well as Viking, but the differences were not significant.

Of the late strains, the most promising was Iowa 3019. In yield and survival it equalled Leo. N6-128 was a good second.

The test is now in bad shape. It is polluted with dandelions and volunteer white clover, and in some spots washing has occurred. It is my intention, for these reasons, to plow up the test to prevent dandelions from polluting the surrounding area and because we have achieved an evaluation both of yield potential and hardiness.

The strain variously designated as Royal, leafy C1, or OAC Synthetic, has now been licensed in Canada under the name of Maitland. One hundred and thirty pounds of breeder seed were sown this spring to yield foundation and certified seed in 1970 and thereafter.

ALABAMA

Sericea Lespedeza and Arrowleaf Clover

Carl S. Hoveland (Auburn)

Sericea Lespedeza

Grazing studies with beef cows and calves were conducted over a 4-year period on droughty, eroded clay soils of the Piedmont. Calf gain was similar on Sericea sericea (a new fine-stemmed variety) and Coastal bermudagrass (with 100 lb/A N), averaging 180 lb/A gain annually. Sericea sericea furnished 126 cow-calf grazing days per acre per year, as compared with 103 days for Coastal bermuda receiving 100 lb/A N. Both pasture species furnished 6 to 8 weeks additional cow grazing in late summer and fall after calves were weaned. Sericea sericea furnished earlier spring grazing and at lower cost than Coastal bermudagrass.

Yuchi Arrowleaf Clover

Acreage of Yuchi arrowleaf (Trifolium vesiculosum) clover, released in 1964, is increasing each year in Alabama. In the spring of 1968 there were over 10,000 acres, and in 1969 the figure will be much higher. Crimson clover acreage, both for forage and seed production, has declined sharply. Certified Yuchi seed production in 1969 is nearly equal to all certified crimson clover varieties in the State.

Dry forage yields of Yuchi arrowleaf averaged 4,800 lb/A as compared to 3,160 lb/A for crimson clover over a 6-year period at Prattville in central Alabama. In this area the productive season extended from December or January to June. Digestible dry matter, as measured by the in vivo nylon bag method, remained above 65% throughout the productive season.

Publications

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2. Donnelly, E. D. and N. A. Minton. 1968. Nematode resistant sericea--now possible. Auburn Univ. Agr. Exp. Sta. Highlights of Agr. Res. 15(2).

3. Hoveland, C. S. 1968. Tall growing Yuchi arrowleaf alternative to crimson in Southeast. *Crops and Soils* 20(9):22-23.

4. Hoveland, C. S., W. B. Anthony, R. R. Harris, E. L. Mayton, and H. E. Burgess. 1969. *Seralea sericea*, Coastal bermuda, Goar tall fescue grazing for beef cows and calves in Alabama's Piedmont. Auburn Univ. Agr. Exp. Sta. Bul. 388.

5. Hoveland, C. S., E. L. Carden, W. B. Anthony, and J. P. Cunningham. 1968. Management affects yield and quality of Yuchi arrowleaf clover. Auburn Univ. Agr. Exp. Sta. Highlights of Agr. Res. 15(4).

6. Hoveland, C. S. and E. D. Donnelly. 1968. A comeback for *sericea lespedeza*. *Crops and Soils* 21(2):18-19.

7. Logan, R. H., C. S. Hoveland, and E. D. Donnelly. 1969. A germination inhibitor in the seedcoat of *sericea (Lespedeza cuneata)* (Dumont) G. Don.). *Agron. J.* 61:265-266.

8. Sturkie, D. G. 1968. Time of planting and mixtures of crownvetch in Alabama. *Proc. 2nd Crownvetch Symposium*, p. 15-20.

9. Sturkie, D. G. 1969. Time of planting crownvetch in Alabama. Auburn Univ. Agr. Exp. Sta. Highlights of Agr. Res. 16(1).

COLORADO

Astragalus cicer--Agronomic Characters and Self Fertility

C. E. Townsend (Fort Collins)

An Astragalus cicer evaluation nursery was started at Fort Collins, Colorado, in May 1968. Approximately 1,800 seedlings of 22 accessions were space planted in a replicated trial. Notes were taken on such agronomic characters as vigor, height, spread, date of flowering, and growth habit. The number of leaflets per leaf was counted and the length of leaf was measured for three leaves on 1,146 plants of A. cicer and other Astragalus species. A correlation coefficient, using the average of the three values, was calculated. Even though the two characters were highly significantly correlated (0.32), they were of low predictive value. The correlation coefficient between number of leaflets per

leaf and vigor for 774 A. cicer plants was nonsignificant (-0.07). The correlation coefficient for length of leaf and vigor for the same 774 plants was highly significant (-0.15), but of extremely low predictive value. Consequently, the number of leaflets per leaf and length of leaves are not a measure of plant vigor in this population.

The number of seeds per pod on two open pollination heads and on two selfed heads was determined for approximately 450 A. cicer plants. The two heads used for selfing were placed in a single cotton muslin bag prior to floret opening. When the florets were ready for manipulation, the heads were rolled with the thumb and fingers. Seed set was measured by counting the total number of seeds per head on an individual pod basis. Many OP seed heads contained 200 to 300 seeds each. Most plants set some selfed seed, although the amount was generally low. Several plants were fairly self-compatible because 50 to 62 selfed seeds per head were obtained.

FLORIDA

Evaluation of Several Clovers

L. S. Dunavin (Jay)

Five replications of these clovers were planted by hand on a Red Bay fine sandy loam soil on 8 October 1968. An application of 500 lb/A of 0-14-14 was disked into the soil prior to planting. Planting was done in 1- by 12-foot rows, which was a departure from our usual broadcast plots. Height measurements were made throughout the winter, but harvesting was delayed until crimson clover was in full bloom. A second harvest was made in about one month. Plants were hand clipped to a height of 2 inches at the first harvest and at soil surface at the second harvest. Yields of crimson clover were generally lower than last year. The weather was such that the season was rather short. Of particular interest was the unexpected high yield of sub clover. The very low clipping of the second harvest allowed for removal of this sub clover forage in a manner somewhat like removal of a fleece, and this undoubtedly would have affected any subsequent harvests had they been made. Use of forage growing at such a low level is rather restricted except under specific situations. Data are presented in Tables 1 and 2.

Table 1. Dry matter yields in pounds per acre of several clovers.
West Florida Experiment Station, Jay, Florida

| Clover Varieties | Number | Yield | | Total |
|-------------------------------------|--------------|----------------------------|------------------------------|-------|
| | | First Harvest 4/9/69 | Second Harvest 5/13/69 | |
| Arrowleaf (<u>T. vesiculosum</u>) | | | | |
| Amclo | F.C. 39,552 | 163 | 4175 | 4338 |
| Meechee | F.C. 39,559 | 472 | 3527 | 3999 |
| <u>T. vesiculosum</u> | P.I. 279,948 | 0 | 1794 | 1794 |
| Yuchi | F.C. 39,539 | 271 | 3915 | 4186 |
| Ball (<u>T. nigrescens</u>) | F.C. 39,380 | 304 | 3513 | 3817 |
| Cluster (<u>T. glomeratum</u>) | F.C. 39,078 | 92 | 2368 | 2460 |
| Crimson (<u>T. incarnatum</u>) | | | | |
| Auburn | F.C. 39,590 | 2461 | 305 | 2766 |
| Autauga | F.C. 39,588 | 2613 | 381 | 2994 |
| Chief | F.C. 39,547 | 2825 | 740 | 3565 |
| Domestic | F.C. 39,544 | 2334 | 277 | 2611 |
| Early Reseeding | F.C. 39,545 | 3293 | 397 | 3690 |
| Frontier | F.C. 39,546 | 2949 | 319 | 3268 |
| Lappa (<u>T. lappaceum</u>) | F.C. 39,556 | 198 | 2203 | 2401 |
| Persian (<u>T. resupinatum</u>) | | | | |
| Abon | F.C. 39,429 | 321 | 2747 | 3068 |
| Rabbit-foot (<u>T. arvense</u>) | WFES 68-3-6 | 0 | 3187 | 3187 |
| Rose (<u>T. hirtum</u>) | WFES 68-6-2 | 559 | 3224 | 3783 |
| Rose | F.C. 39,560 | 885 | 2008 | 2893 |
| Strawberry (<u>T. fragiferum</u>) | | | | |
| Salina | F.C. 39,454 | 109 | 1087 | 1196 |
| Sub (<u>T. subterraneum</u>) | | | | |
| Bacchus Marsh | F.C. 39,583 | 957 | 6151 | 7108 |
| Miss. Ecotype | F.C. 39,080 | 321 | 6180 | 6501 |
| Miss. Ecotype | F.C. 39,557 | 272 | 6007 | 6279 |
| Mt. Barker | F.C. 39,584 | 467 | 6392 | 6859 |
| <u>T. angustifolium</u> | WFES 68-3-5 | 539 | 4376 | 4915 |
| <u>T. cherleri</u> | WFES 68-5-13 | 259 | 2556 | 2815 |
| <u>T. desvauxii</u> | WFES 68-5-12 | 550 | 2358 | 2908 |
| <u>T. isthmocarpum</u> | WFES 68-6-5 | 237 | 3074 | 3311 |
| <u>T. meneghinianum</u> | WFES 68-6-11 | 62 | 1788 | 1850 |
| <u>T. miegeanum</u> | WFES 68-6-13 | 436 | 2047 | 2483 |

Table 2. Heights in inches of several clones on various dates.
West Florida Experiment Station, Jay, Florida

| Clover Variety | Number | 1968 | 1969 | | | |
|-------------------------------------|--------------|-------|------|------|------|------|
| | | 12/10 | 1/9 | 2/24 | 4/9 | 5/13 |
| Arrowleaf (<u>T. vesiculosum</u>) | | | | | | |
| Amclo | F.C. 34,552 | 0.3 | 0.4 | 0.8 | 3.9 | 15.0 |
| Meechee | F.C. 39,559 | 0.3 | 0.4 | 1.0 | 3.9 | 12.5 |
| <u>T. vesiculosum</u> | P.I. 279,948 | 0.2 | 0.3 | 0.5 | 1.8 | 7.3 |
| Yuchi | F.C. 39,539 | 0.2 | 0.4 | 0.9 | 3.8 | 14.5 |
| Ball (<u>T. nigrescens</u>) | F.C. 39,380 | 0.1 | 0.3 | 0.9 | 4.6 | 8.0 |
| Cluster (<u>T. glomeratum</u>) | F.C. 39,078 | 0.1 | 0.2 | 0.6 | 2.4 | 6.3 |
| Crimson (<u>T. incarnatum</u>) | | | | | | |
| Auburn | F.C. 39,590 | 0.6 | 1.0 | 1.8 | 16.2 | 10.5 |
| Autauga | F.C. 39,588 | 0.5 | 1.1 | 1.8 | 8.8 | 10.0 |
| Chief | F.C. 39,547 | 0.6 | 1.3 | 1.9 | 16.3 | 12.3 |
| Domestic | F.C. 39,544 | 0.7 | 1.2 | 1.9 | 17.0 | 10.3 |
| Early Reseeding | F.C. 39,545 | 0.6 | 1.2 | 2.1 | 17.4 | 10.0 |
| Frontier | F.C. 39,546 | 1.1 | 1.6 | 2.4 | 18.0 | 9.5 |
| Lappa (<u>T. lappaceum</u>) | F.C. 39,556 | 0.1 | 0.2 | 0.9 | 2.4 | 5.0 |
| Persian (<u>T. resupinatum</u>) | | | | | | |
| Abon | F.C. 39,429 | 0.4 | 0.5 | 1.9 | 4.9 | 16.3 |
| Rabbit-foot (<u>T. arvense</u>) | WFES 68-3-6 | 0.1 | 0.2 | 0.4 | 2.1 | 11.0 |
| Rose (<u>T. hirtum</u>) | WFES 68-6-2 | 0.3 | 0.5 | 1.1 | 3.5 | 8.5 |
| Rose | F.C. 39,560 | 0.6 | 0.8 | 1.6 | 7.4 | 7.0 |
| Strawberry (<u>T. fragiferum</u>) | | | | | | |
| Salina | F.C. 39,454 | 0.1 | 0.3 | 1.1 | 2.3 | 6.0 |
| Sub (<u>T. subterraneum</u>) | | | | | | |
| Bacchus Marsh | F.C. 39,583 | 0.5 | 0.6 | 1.1 | 3.0 | 4.3 |
| Miss. Ecotype | F.C. 39,080 | 0.4 | 0.5 | 0.9 | 1.8 | 4.8 |
| Miss. Ecotype | F.C. 39,557 | 0.4 | 0.5 | 0.7 | 1.7 | 5.0 |
| Mt. Barker | F.C. 39,584 | 0.3 | 0.6 | 0.9 | 2.5 | 4.5 |
| <u>T. angustifolium</u> | WFES 68-3-5 | 0.3 | 0.5 | 1.2 | 4.1 | 14.0 |
| <u>T. cherleri</u> | WFES 68-5-13 | 0.2 | 0.2 | 0.7 | 1.7 | 2.5 |
| <u>T. desvauxii</u> | WFES 68-5-12 | 0.4 | 0.4 | 1.0 | 4.4 | 4.5 |
| <u>T. isthmocarpum</u> | WFES 68-6-5 | 0.4 | 0.5 | 1.0 | 2.8 | 8.3 |
| <u>T. meneghinianum</u> | WFES 68-6-11 | 0.2 | 0.2 | 0.5 | 1.5 | 12.3 |
| <u>T. miegeanum</u> | WFES 68-6-13 | 0.5 | 0.5 | 1.1 | 3.7 | 8.3 |

GEORGIA

Forage Yield, Harvest Time, and Seed Production of Vetches

E. R. Beaty and John D. Powell (Athens and Americus)

Vetch (Vicia spp.) is a legume that has been widely used in the South as a green manure crop. With the introduction of synthetic nitrogen materials, green manure crops became less important and the emphasis on vetches shifted to their value as forage crops.

As forage crops, vetches have both advantages and disadvantages. Most are hardseeded, reseeding, cold resistant, and give satisfactory yields of relatively high quality forage. Their disadvantages are short periods of forage productivity and seed shatter.

The ironic part of the whole matter is that variation present within the genus suggests that it should be possible to produce a vetch that would combine many of the desirable characteristics by breeding or introductions from other countries.

The purpose of this investigation was to compare forage yield, time of forage production, and seed shatter of three introductions of Vicia lutea L. with that of the better known V. grandiflora.

Procedure: The seedlings were made in 1966, 1967, and 1968 at the Americus Plant Materials Center, Americus, Georgia. Vicia lutea introductions P.I. 249,800, AM-87 Dadeville, and AM-85 Pickens and V. grandiflora AM-304 were seeded on Orangeburg sandy loam at the rate of 30 pounds per acre. Seeding was completed between October 9 and 20 of each year on a completely prepared seedbed. Plots consisted of 7 rows 1-foot wide and 20-feet long. Fertilization consisted of 500 pounds of 0-14-14 per acre, and treatments were replicated four times in a RCB design. Single forage harvests were made at full bloom.

Results: Forage production is shown in table 1. Forage yields were similar in 1967 and for the 3-year average. In 1968, V. grandiflora was approximately two times as productive as V. lutea. In 1969, however, the three varieties of V. lutea increased production while the V. grandiflora decreased.

The year-to-year variation in forage production was closely related to rainfall at the time of spring growth. In 1968, plants that grew before May 1 were favored, while in 1969 those that grew after May 1 had the higher rainfall.

Clipping at time of full flower influenced yields also. Grandiflora blooms over approximately a 1-month period, and clipping at early bloom could reduce forage yields. Grandiflora was clipped in this investigation between April 10 and 23. The V. lutea varieties were clipped at full bloom between April 27 and May 21.

Forage production of V. lutea was essentially equal, and all growth characteristics tended to be similar. Selection among the V. lutea varieties should probably be on characteristics other than forage yields.

Seed harvest on the Center has been limited. With V. grandiflora, mechanical harvest of seed is not practical due to the month-long indeterminate flowering period being followed by early seed shatter. Seed harvest by combining at one time is likely to be below 50 pounds per acre.

While seed of the V. lutea varieties will shatter, the rather determinate flowering and weak-shatter tendency make possible yields of 600 pounds or more per acre by combining.

Table 1. Forage yields of Vicia spp., 1967-1969, Americus, Ga.

| <u>Variety</u> | <u>Year</u> | | | <u>3-year Average</u> |
|----------------------|----------------------------------|-------------|-------------|---------------------------|
| | <u>1967</u> | <u>1968</u> | <u>1969</u> | |
| | <u>Pounds of forage per acre</u> | | | |
| Dadeville AM-87 | 3778 | 2353 | 5388 | 3840 |
| P.I. 249,880 AM-1466 | 3754 | 2378 | 5242 | 3788 |
| Pickens AM-85 | 3724 | 1842 | 5028 | 3531 |
| Grandiflora AM-304 | 3495 | 4571 | 3164 | 3743 |
| LSD (5%) | NS | 445 | 566 | |

Crownvetch and Birdsfoot Trefoil

Robert E. Burns (Experiment)

Crownvetch

Crownvetch varieties were planted March 6, 1967, on land treated with 1/2-gallon per acre of Eptam and fertilized each spring with 500 pounds of 0-10-10. The "K-63" plots were mainly sweetclover.

Yields were not determined in the year of establishment. In 1968 three cuttings were made. Chemung and Emerald yielded more than Penngift or K-63 (table 1). Apparently the cutting regime was not satisfactory since most of the plots did not have a satisfactory stand in the spring of 1969.

Ga 1 crownvetch, a strain which developed from random crosses between Penngift and 64-6, has shown promise in some tests. A seed plot has been established, and we hope to have seed for test purposes in the fall of 1969.

Table 1. Forage yields of crownvetch varieties.
Experiment, Georgia, 1968

| <u>Variety</u> | <u>Harvest Date</u> | | | <u>Total</u> |
|----------------|---------------------|-------------|-------------|--------------|
| | <u>4/17</u> | <u>5/21</u> | <u>7/18</u> | |
| Chemung | .45 | 1.30 | 1.92 | 3.37 |
| Emerald | .35 | .90 | 1.85 | 3.10 |
| Penngift | .06 | .91 | .85 | 1.82 |
| K-63* | .14 | 1.20 | 1.52 | 2.86 |

* Sweetclover comprises most of the forage on these plots.

Birdsfoot Trefoil

Three isolated blocks of birdsfoot trefoil are planted at Experiment. These are progeny of crosses made by Dr. Howard Johnson between a Brazilian collection and a local strain and backcrossed to the local strain. One of the blocks contains selections made by Dr. Johnson. The other two are selections of different growth habits made at Experiment. These will be graded this year and inferior plants will be removed. Seed will be harvested next year for test purposes.

Blue Lupine Silage Production: Effect of Seeding Rate
for a Larger- and a Smaller-seeded Variety

Ian Forbes, Jr. (Tifton)

Present recommended seeding rates for blue lupine varieties with ordinary-sized seeds are 75 to 100 pounds of seed per acre for grazing or cover crops and 40 pounds for seed fields. Lower seeding rates and thinner plant stands are likely to be satisfactory for silage crops compared to those for pastures. Also, use of the new, smaller-seeded variety 'Frost' might permit lighter seeding rates for silage production than would the ordinary-size-seeded variety 'Rancher'. Frost has about 1 1/2 times as many seeds per pound as Rancher. In October 1968 a field test was planted that was designed to measure the silage production of Rancher and Frost blue lupine when seeded in 6-inch drill rows at the rates of 20, 40, 60, 80, and 100 pounds of seed per acre. Plots 3 x 10 feet in size, replicated 4 times, were used. Forage samples were cut at a 4-inch height on May 8 in the case of Rancher and on May 12 in the case of the later-maturing Frost.

Results (table 1) indicate that Rancher silage yields were significantly greater at the 40- than at the 20-pound seeding rate and did not increase at higher rates. For Frost, the silage yield was significantly greater at the 80- than at the 20-pound rate, but the yield at the 80-pound rate was not significantly higher than yields at the 40-, 60-, and 100-pound rates.

Table 1. Effect of seeding rate on forage yields of Rancher and Frost blue lupine when cut for silage at Tifton, Ga., in 1969.

| <u>Variety and seed size</u> | <u>Dry forage produced when drilled at the indicated seeding rates per acre</u> | | | | |
|----------------------------------|---|---------------|---------------|---------------|----------------|
| | <u>20 lbs</u> | <u>40 lbs</u> | <u>60 lbs</u> | <u>80 lbs</u> | <u>100 lbs</u> |
| | Pounds per Acre | | | | |
| Frost--small | 6,475 | 7,179 | 7,421 | 7,923 | 7,541 |
| Rancher--large | 8,768 | 10,779 | 9,311 | 10,960 | 9,814 |

LSD (.05) for forage production = 1,186 pounds per acre.

Based on these results alone a seeding rate of 40 lb/A for silage production of either Frost or Rancher would be most satisfactory. Additional tests of this kind are needed because variable results may be obtained in future years having different weather conditions. The 1968-69 winter was colder, and cold temperatures lasted later into the spring than usual. These temperature conditions could be expected to reduce yields of Frost more than those of Rancher because Frost has a higher temperature threshold for vegetative growth than does Rancher.

Publications

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3. Forbes, Ian, Homer D. Wells, Robert E. Burns, James W. Dobson, and John R. Edwardson. 1969. Frost blue lupine: A winter-hardy, disease-resistant forage variety for temporary winter pastures. Ga. Agron. Abstr. 1969:4.

The Cross-pollination Rate of Early- and Late-maturing Blue Lupine Biotypes with Variable Amounts of Protection Against Insect Visitation at Tifton, Georgia, in 1969

Ian Forbes, Jr. and D. B. Leuck (Tifton)

Previous tests of the amount of cross-pollination taking place in blue lupine at Tifton indicated that none was taking place in early-maturing biotypes in 1953, 1954, and 1967 (see Newsletter 2:7). However, in 1966 a small percentage of outcrossed seedlings (0.139%) were identified in large populations (79,680 seedlings) of 14 late-maturing, winterhardy breeding lines. In 1967, 0.14% out-crosses were detected among 10,405 seeds from a cross-pollination test of 65G-251, a late-maturing, winterhardy breeding line (Newsletter 2:7). Insect visitation studies in 1967 indicated that honey bees were the most common visitors to the blue lupine flowers, although some bumble bee visitors were observed. All of these data were obtained from test sites having only moderate bee population densities. This paper reports a study designed to gain more information regarding the identity of the insects responsible for cross-pollination in blue lupine, and to determine whether or not certain mechanical barriers would prevent cross-pollination.

In 1968, two cross-pollination tests were established in a location known to have extremely high population densities of both domestic and wild bees. The site chosen was also protected from wind by woods on three sides and by a hill on the fourth. Thus, the site was favorable for maximum bee visitation of the flowers. Female parent hills (the seeds from which would be harvested and identified as selfs or crosses) were given one of three treatments.

1. An open-topped enclosure of fine-meshed plastic screen.
2. An open-topped enclosure of 1-inch mesh poultry wire.
3. No enclosure.

In two adjacent tests, early-maturing 'Rancher' and a late-maturing breeding line 65G-251, were used as female parents. Female parent hills were planted 15-feet apart in rows of the male parent, which were 3-feet apart. The female hills were staggered in adjacent rows. Bulk seed harvests were made from the female hills for each treatment on three dates. The seeds were germinated in flats in the greenhouse and identified as selfs or crosses based on seedling color (green or purplish).

The highest cross-pollination rate ever recorded at Tifton occurred in these tests (table 1). For the first time cross-pollination was detected in early-maturing Rancher blue lupine. Far more cross-pollination occurred in late-maturing line 65G-251 than in Rancher. This tendency toward greater amounts of cross-pollination in late-maturing biotypes may be related to favorable temperature and other weather conditions in later spring for bee visitation to flowers. In both tests, 1-inch mesh poultry wire reduced cross-pollination some, and fine-meshed screen reduced it greatly. These results would be expected if the honey bee and/or small wild bees, rather than bumble bees or thrips, were responsible for most of the cross-pollination detected. The poultry mesh would be expected to prevent flower visitation by bumble bees, but it would not be expected to interfere greatly with visitation by smaller bees. The low rate of cross-pollination inside the fine-mesh screen barriers could be attributed to honey bees which entered the open top and were occasionally observed inside the barrier. If thrips had been the major source of cross-pollination, higher cross-pollination rates would be expected inside the fine-mesh screen barrier. Also, lower cross-pollination rates would not be expected among later-harvested seeds because thrips populations increase until the pollen supply is exhausted. On the other hand, honey bees are likely to stop working a particular crop as the flower supply decreases, and a lower cross-pollination rate would result among later-ripened seeds.

Table 1. The cross-pollination rate of an early- and a late-maturing cultivar of blue lupine given different degrees of protection against insect pollination at Tifton, Georgia, in 1968.

| Type of barrier to insect visitation* | Seed harvest Date | Classification of seeds harvested | | | Rate of cross-pollination | |
|---|-------------------------|--------------------------------------|----------------|--------------|------------------------------|-----------------------|
| | | Selfed No. | Crossed No. | Total No. | Each | All |
| | | | | | harvest Date % | harvests Avg. % |
| | | | | | | |
| <u>Rancher -- Early Maturing</u> | | | | | | |
| None | May 14 | 18,312 | 912 | 19,224 | 4.74 | |
| None | May 17 | 7,143 | 139 | 7,282 | 1.91 | |
| None | May 23 | 4,422 | 18 | 4,440 | .41 | 3.45 |
| Fine mesh screen | May 14 | 4,943 | 12 | 4,955 | .24 | |
| Fine mesh screen | May 17 | 1,546 | 0 | 1,546 | 0.00 | |
| Fine mesh screen | May 23 | 1,008 | 0 | 1,008 | 0.00 | 0.15 |
| 1" poultry mesh | May 14 | 4,776 | 145 | 4,921 | 2.95 | |
| 1" poultry mesh | May 17 | 1,805 | 29 | 1,834 | 1.58 | |
| 1" poultry mesh | May 23 | 761 | 1 | 762 | .13 | 2.33 |
| <u>65G-251 -- Late Maturing</u> | | | | | | |
| None | May 17 | 8,516 | 2,278 | 10,794 | 21.10 | |
| None | May 23 | 11,680 | 776 | 12,456 | 6.23 | |
| None | June 4 | 2,652 | 47 | 2,699 | 1.74 | 12.00 |
| Fine mesh screen | May 17 | 2,570 | 84 | 2,654 | 3.17 | |
| Fine mesh screen | May 23 | 5,344 | 82 | 5,426 | 1.51 | |
| Fine mesh screen | June 4 | 1,728 | 11 | 1,739 | .63 | 1.80 |
| 1" poultry mesh | May 17 | 4,638 | 889 | 5,527 | 16.08 | |
| 1" poultry mesh | May 23 | 8,507 | 429 | 8,936 | 4.80 | |
| 1" poultry mesh | June 4 | 988 | 19 | 1,007 | 1.92 | 8.64 |

* Barriers consisted of open-topped enclosures of the material indicated surrounding the mother-plants hills (3 x 3 feet) and 6- to 12-inches taller than the mother plants at maturity.

It is apparent from the data that open-topped, fine-meshed screen barriers reduce cross-pollination, but the reduction is not adequate for some purposes in breeding programs. Whereas much of the time bees that fly up to the barrier fly completely over the enclosure, they occasionally make their way inside. Another test using covered tops to the barriers is planned for the 1968-69 crop year.

These results indicate that the location of blue lupine plantings close to high-density bee populations can greatly increase the cross-pollination rate that occurs.

IDAHO

Domestic Exploration for Lupines

A. E. Slinkard (Moscow)

In 1968 a domestic exploration resulted in the collection of 71 accessions of native lupines from Idaho, eastern Washington, eastern Oregon, and western Montana. All accessions except one were perennials. These are being increased, and seed should be available through the Plant Introduction Service in late 1970.

ILLINOIS

Crownvetch Seeding Rate Trials

Don W. Graffis (Urbana)

A seeding rate trial with crownvetch was seeded April 25, 1968, on a seedbed in which 3 lb/A of Eptam had been incorporated. The seed was evenly broadcast on a rolled seedbed, and the seed was rolled into the firmed seedbed.

Weeds were not well controlled by the Eptam, and seedling growth rate of the crownvetch was so slow that weeds became a severe contaminant and competitor. No yield data was obtained during the seeding year.

Stands in the spring of 1969 were adequate to justify harvesting. Yields for the 1st and 2nd cuts, 1969, are given in the following table.

Crownvetch Dry Matter Yield at Different Seeding Rates
Urbana, Illinois

| <u>Harvest Date</u> | <u>Seeding Rates, Lb/A, 4/25/68</u> | | | |
|---------------------|-------------------------------------|-----------|-----------|-----------|
| | <u>6</u> | <u>12</u> | <u>18</u> | <u>24</u> |
| | Tons/A | | | |
| May 25 | 1.11 | 1.14 | 1.33 | 1.24 |
| June 27 | .70 | .77 | .96 | .87 |

A seeding of sainfoin was attempted on the same seedbed as described above. Few plants were established and the trial has been abandoned.

Birdsfoot Trefoil Variety Trials

Carl N. Hittle (Urbana)

Trefoil Variety Trial, Experiment 632
Agronomy South Farm (Field 751-58), Urbana, Illinois
Seeded April 18, 1967 -- 1968 Data

| Variety or strain | F.C. No. | Vigor ^{a/} 6-10 | Bloom 6-10 % | D.M. Yield | | | |
|-----------------------------------|-------------|-----------------------------|--------------------|-------------|-------------|-------------|--------------|
| | | | | 6-10 T/A | 7-19 T/A | 8-21 T/A | Total T/A |
| Cascade | 38,534 | 5.2 | 35 | 1.13 | .93 | .96 | 3.02 |
| Granger | 37,931 | 5.0 | 35 | 1.15 | .95 | 1.05 | 3.15 |
| Leo | 39,057 | 2.2 | 2 | 1.93 | 1.39 | .94 | 4.26 |
| Mansfield | 37,948 | 3.5 | 26 | 1.35 | 1.05 | 1.00 | 3.40 |
| Viking | 37,919 | 4.0 | 32 | 1.37 | .99 | .97 | 3.33 |
| N6-128 | 39,469 | 4.2 | 3 | 1.26 | .68 | .95 | 2.89 |
| Dawn | 39,443 | 2.5 | 8 | 1.49 | .88 | 1.02 | 3.39 |
| Dawn (King City, Baldridge) | | 3.0 | 6 | 1.59 | .91 | 1.12 | 3.62 |
| Empire | 37,094 | 5.0 | 4 | .99 | .76 | .82 | 2.57 |
| Mc-H-66 | 39,448 | 2.0 | 6 | 1.87 | 1.54 | 1.03 | 4.44 |
| Va. Syn-5 | 39,465 | 4.0 | 29 | 1.52 | 1.21 | 1.02 | 3.75 |
| Va. Syn-6 | 39,466 | 2.5 | 80 | 1.58 | 1.09 | 1.04 | 3.71 |
| V-15 (N.Y.) | 39,468 | 3.0 | 18 | 1.65 | 1.12 | 1.01 | 3.78 |
| P-15456 | 39,471 | 3.2 | 4 | 1.45 | .66 | .95 | 3.06 |
| Purdue Syn A | 39,482 | 3.0 | 16 | 1.56 | 1.41 | .96 | 3.93 |
| Empire (Iowa-- 3rd Gen.) | | 2.2 | 1 | 1.57 | .79 | .90 | 3.26 |
| Mo-10 (Empire Sel) | | 4.0 | 20 | 1.36 | 1.04 | .88 | 3.28 |
| Mo-110 (European Sel) | | 3.8 | 32 | 1.47 | 1.15 | 1.14 | 3.76 |
| Iowa R-1 (Wilsie) | | 1.5 | 2 | 2.04 | 1.37 | .96 | 4.37 |
| Iowa E-1 (Wilsie) | | 6.0 | 2 | 1.06 | .76 | .87 | 2.69 |
| LSD 5% | | 1.43 | 8.35 | .27 | .20 | .12 | |
| 1% | | 1.91 | 11.11 | .36 | .27 | .16 | |
| CV in % | | 29.06 | 32.53 | 13.19 | 13.76 | 8.52 | |
| Mean | | 3.5 | 18 | 1.47 | 1.03 | .98 | 3.48 |

^{a/} Vigor rating: 1 = best, 9 = least.

Design--RCB in 4 replications; Plot size planted--5 x 25 ft; Plot size harvested--40 in. x 21 ft; Date of seeding-- April 18, 1967; Method of seeding--broadcast and rolled; Rate of seeding--7.7 lb/A; Soil type--Flanagan and Drummer silt loam; Condition of seedbed--excellent.

IOWA

Effects of Defoliation Frequency
on Improved Birdsfoot Trefoil Varieties
 (Progress Report--1968)

W. F. Wedin (Ames)

A trefoil variety-management study was seeded in 1967, with first production year yields taken in 1968. The primary objectives of this study were to:

1. Evaluate two large-seeded breeding selections with the recommended variety, Empire.
2. Evaluate the performance of Dawn birdsfoot trefoil, a new release from the University of Missouri and the U.S. Department of Agriculture.

Establishment, 1967

Land was fall-plowed in 1966 and disked thoroughly in the spring of 1967. Fertilizer applied May 13, 1967, was 20-36-68 of N-P-K. Eptam was applied at 3 lb/A on May 13, and the area was immediately disked and dragged. Seeding was with a Planet, Jr. seeder. Weed control was very satisfactory for approximately 5 weeks. Weeds were clipped on July 25. Fertilizer applied in the fall of 1967 was 0-18-35 of N-P-K. No additional fertilizer was applied in 1968.

Forage Yields in 1968

Two managements were imposed on the trefoil varieties. Pasture management was defined as 5 cuts per season and Hay management as 3 cuts. The yields averaged over managements and varieties are presented in the following table.

Average Dry Matter Yields in Tons per Acre for Birdsfoot Trefoil,
 Shelby-Grundy Experimental Farm. 1968

| Management ¹ | Empire | Russian | | Dawn | Avg. |
|-------------------------|--------|---------------------------------|------------------------------------|------|------|
| | | Large Seed R-1 Acc. #3019 | Empire Large Seed Acc. #3020 | | |
| Pasture (5 cuts) | 2.50 | 2.82 | 2.17 | 2.71 | 2.54 |
| Hay (3 cuts) | 2.99 | 3.36 | 2.71 | 3.30 | 3.09 |
| Average | 2.74 | 3.09 | 2.44 | 3.00 | 2.82 |

¹ Harvest dates: (Pasture) June 6, June 27, July 24, August 15, September 9; (Hay) June 13, July 25, September 9.

Among varieties, the large-seeded Russian selection was highest yielding, followed by Dawn. The former has not been released but is being carefully evaluated by plant breeders at Iowa State University for possible release. Dawn, the new variety released at the University of Missouri, was second highest yielding over both managements. This variety has some root rot resistance not found in Empire. It is reasoned that this will be an excellent variety for southern Iowa. Empire was higher yielding than the large-seeded selection from Empire.

All varieties yielded more total dry matter under the hay cutting management. Over all varieties, this increase was approximately 0.5 ton per acre.

The variety-management test is continuing in 1969.

Grazing Management of Emerald Crownvetch^{1,2}
(Progress Report, 1968)

W. F. Wedin, R. L. Vetter, and W. B. Bryan

An exploratory grazing study and a detailed small-plot study with Emerald crownvetch was conducted at the Western Iowa Experimental Farm, Castana, Iowa, in 1964 and 1965. This research indicated that crownvetch could be a useful pasture crop in western Iowa.

This present study was initiated (1) to determine how Emerald crownvetch persists under either moderate or heavy grazing pressures, (2) to determine the performance of grazing animals, and (3) to determine production per acre in terms of total gain.

Establishment

An extremely hilly site, approximately 18 acres in size, is being used for this study. In the spring of 1967, the entire field was fertilized with 39.6 lb/A of P (90 lb. P₂O₅) and plowed. Following disking and harrowing, the herbicide Eptam 6E, at 3 lb/A in approximately 10 gallons of water, was sprayed on the soil surface on May 17. Disking followed immediately to incorporate the herbicide into the soil.

¹ Emerald crownvetch seed was provided by the Soil Conservation Service, U.S. Department of Agriculture.

² Eptam 6E was provided courtesy of Stauffer Chemical Company.

On the following day (May 17, 1967), inoculated Emerald crown-vetch was broadcast with a drill at 10 lb/A. Packing was accomplished with a roller.

Emergence was excellent and weed control was initially effective because of Eptam. However, weeds came in such that clipping was needed by July 10 and again on August 1.

Grazing Year 1 (1968)

Stand: Stand was adequate but not outstanding in 1968. In June, some weeds were evident, but they were not a serious problem. When grazing commenced on June 18, the crownvetch was approximately 50% in bloom. Smooth brome is present in terraces and waterways.

Fertilization: In the spring of 1968 the pastures were fertilized with 35.2 lb P (80 lb P_2O_5) and 33 lb K (40 lb K_2O) per acre.

Grazing treatments: Because the ability of Emerald crownvetch to persist under varying grazing pressure is still subject to question, two grazing pressures were used in our study. Moderate grazing in this case is defined as that pressure which appears to best utilize the forage without apparent harm to the plant. This is a very subjective and arbitrary level. Consequently, it was decided that another grazing pressure should be used. Thus, the heavy pressure was defined as 25 to 50% greater.

Grazing management: The 18-acre field was divided with electric fencing into eight pastures, each approximately 2.3 acres in size. Water was available in each pasture. Both treatments were repeated on two replicates. Tester and grazer steers were designated and grazing pressures were adjusted using "put and take" animals (grazers). Tester steers remained on pasture throughout the season. One-half of each pasture was grazed continuously for intervals of 24 to 32 days, after which steers were moved to the other one-half. Clipping of ungrazed weeds was necessary at times. All clipping was 6 inches in height.

Grazing animals used: Yearling steers that had originated in Texas were used. They were of mixed breed, varying from Hereford and Aberdeen Angus to Brahma crosses. Their average weight at the beginning of the study was 620 lb. They were weighed at 4-week intervals up to September 10 and again on September 24 when grazing ended.

Results: Average daily gain, steer days per acre and beef produced per acre values in 1968 are presented in the accompanying table. Approximately one-third more steers were carried on the heavy grazing treatment than on moderate grazing treatment. This

resulted in a drop in average daily gain; however, this also resulted in an increase of approximately 25% in beef produced per acre under heavy grazing. Moderate grazing, in effect, resulted in the carrying of one steer per acre for 98 days. However, half or more of this production was obtained over the first 4 weeks of grazing in June and July.

The experiment is continuing, as it is important to know how well these stands of crownvetch will persist over time.

Crownvetch Pasture Management Study
Western Iowa Experimental Farm--1968^a

| Grazing pressure ^b | Average daily gain lb. | Steer days per acre | Beef per acre lb. |
|-------------------------------|------------------------|---------------------|-------------------|
| Moderate | 1.61 | 97 | 156 |
| Heavy | 1.48 | 134 | 198 |

^a Grazed from June 18 to September 24 (98 days), 1968.

^b Heavy grazing pressure was applied by using 25 to 50% more steers than on moderate grazing.

Fertilization and Management
to Rejuvenate Established Birdsfoot Trefoil Stands
(Progress Report, 1968)

W. F. Wedin and R. L. Vetter

An 8-year study, completed in 1963, clearly showed the value of birdsfoot trefoil (BFT) renovated pastures as compared to either unimproved or grass pasture fertilized with nitrogen (N) and phosphorus (P) for beef cows and calves (1956-57) and yearling steers (1958-63).

At the summarization of the 1956-63 work, questions arose as follows:

- (1) Why had BFT shown a decline in the pastures, most markedly from 1961 to 1962 to 1963?

- (2) Why had beef produced per acre on BFT pastures declined from 1961--406, 1962--313, 1963--291?

To determine if the gradual reduction in BFT in the pastures and beef production per acre could be arrested, and even reversed, several of the pastures used in the previous experiment (1956-63) were modified in size and arrangement to allow the following comparisons:

- (1) Yields of forage and animal performance on four pasture treatments.
 - (a) Unimproved
 - (b) Grass + 60N, P, K
 - (c) BFT + P, K, (8-year-old stand)
 - (d) BFT + P, K, (8-year-old stand) alternated with grass + 60N, P, K.
- (2) Percentage BFT in (c) and (d) as they compare to the percentage obtained in 1961, 1962, and 1963.

Summary of Results to Date

During 1964, 1965, 1966, 1967, and 1968 the pastures have been grazed with yearling steers. Yields and samples for determining botanical composition have been obtained each year from cages on the pastures.

The BFT + P, K pastures were highest yielding over the 5-year period at 3.11 tons, followed by a 3.03-ton average yield for the BFT + P, K, where alternated with grass + N, P, K. The grass + N, P, K pasture averaged 2.70 tons/A.

Percentages of BFT, grass, white clover, and weeds are based on visual estimates of forage in caged samples (4 cages per pasture in each of 2 replicates at each of the three harvest dates). Following the 1966 grazing season, it appeared that percentage BFT in the BFT + P, K treatment and also in the BFT + P, K treatment (alternated with grass + 60N, P, K) had dropped. However, there now appears to be an increase in percentage BFT and the BFT alternately grazed. This percentage increased from 27 to 30 to 35 for 1966, 1967, 1968, while on BFT continuously grazed the percentage was 22, 20, and 22, respectively.

Each year it has been our objective in grazing management to allow the BFT in the alternately grazed treatment to flower and set seed. It is reasoned that reseeding from established plants is needed. Visual examination of the new growth in the pastures has shown that numerous new plants germinate each year.

The trends in animal performance and beef production per acre show the highest average daily gain and beef production per acre on BFT + P, K (continuously grazed), followed by BFT + P, K (alternated with grass + 60N, P, K), then grass + 60N, P, K, and finally the unimproved pasture.

Beef production on the BFT + P, K (continuously grazed) is being maintained even though the percentage BFT is now less than 25. For 1961, 1962, 1963, the pastures produced an average of 337 pounds of beef annually. For 1964, 1965, and 1966, the average figure was 338. A substantial increase is noted in the average for the two years, 1967 and 1968, where the value was 397 lb/A. At the same time the BFT + P, K (alternately grazed) produced an average of 312 pounds (1967-1968). It must be remembered, however, that these pastures are not grazed as severely because there is the specific objective of increasing BFT in the sward.

In summary, it appears that fertility and management are likely enhancing increases in percentage BFT in the alternately grazed pastures. These pastures, when returned to a continuously grazed management, should be higher yielding. The experiment is continuing.

Effect of Nitrogen (N) on a Birdsfoot Trefoil-Orchardgrass Sward

Oscar Castro and W. F. Wedin

An experiment was conducted at the Shelby-Grundy Experimental Farm, Beaconsfield, Iowa, in southern Iowa during 1966, 1967, and 1968 to determine the effects of N and P applications on an existing birdsfoot trefoil-orchardgrass sward previously established with and without lime application. Dry matter production, botanical composition, and crude protein percentages were determined.

Dry matter yields were significantly increased ($P < 0.01$) by N application at 168 kg/ha/year. For each cut, the application was 56 kg/ha. Each kg N applied increased dry matter yield 7.4 kg. All P treatments significantly increased ($P < 0.01$) dry matter yield, with superphosphate as a source more effective than rock phosphate. Response to lime (9 metric tons/ha at establishment) was non-significant. The response to N decreased from 1966 to 1967 to 1968.

Data on botanical composition indicated that N application significantly decreased ($P < 0.01$) the percentage of legume in the mixture. Phosphorus treatments increased percentage of legume, the increase being most striking when no N was applied. By cuts within years, the trends in percentages of legume were similar, decreasing from cut 1 to cut 2 to cut 3. Percentage grass in the mixture was significantly increased ($P < 0.01$) by N application. Phosphorus and lime had no significant effect on percentage grass. The percentages of weeds in the mixture were significantly reduced by N application ($P < 0.01$), by P treatment ($P < 0.01$), and by lime application ($P < 0.05$).

The crude protein percentages of the legume and grass component were significantly increased ($P < 0.01$) by N application. The magnitude of the response was much greater for the grass component than for the legume component.

The reduction in beneficial response to N application in 1966 to 1968, as indicated by comparative values for the first cuts of each year, suggests that 56 kg N/ha/cut was not sufficient to maintain yields and percentage crude protein of the trefoil-orchardgrass mixture. Because of the shifts which occurred in botanical composition--that is, more grass, less legume--it could be concluded that increased N fertilization with management of the mixture as a pure grass stand would be necessary to maximize yields of this stand.

KENTUCKY

Plant Physiology Studies With Red Clover

W. A. Kendall (Lexington)

Simplification of the Dry Matter Disappearance (DMD) Technique to Estimate Forage Quality.

The technique described by Donefer, et al. (J. Dairy Sci. 46: 956, 1963, and Proc. 19th Intern. Grasslands Congr. 1966:442) to estimate Nutritive Value Index (NVI) of forages was simplified by eliminating the pepsin-digestion apparatus and by using paper in place of glass filters. These changes produced lower DMD values for all forages tested, but with suitable changes in the equation for calculating NVI the final results were identical. Plant species used in this study were bluegrass, brome grass, orchardgrass, alfalfa, big flowered vetch, crownvetch, and red clover.

We incubated our samples for the same time and at the same temperature as recommended by Donefer, et al., but without agitation, in 250 Erlenmeyer flasks in place of the pepsin-digestion apparatus. As a substitute for the glass filters which required cleaning, we used Whatman #1 or S and S #595¹ paper filters. The oven-dried filter papers and papers with residues should be cooled to room temperature and weighed in covered aluminum weighing pans. The equation for calculating NVI from data obtained by the revised method is $Y = -0.75 + 1.67X$.

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¹

Use of a company and/or product name by the U.S. Department of Agriculture does not imply approval or recommendation of the product to the exclusion of others which may also be suitable.

MARYLAND

Breeding for Resistance to the Root Rot Complex
in Birdsfoot Trefoil

P. R. Henson, S. A. Ostazeski, and L. A. Tayman (Beltsville)

Five 2-year cycles of recurrent phenotypic selection have been completed with two gene pools of trefoil plants. The 1969 results on progenies from fifth cycle selections planted in 1968 are shown below.

| | <u>5th Recurrent Cycle</u> | | Check Var. ¹ |
|--|----------------------------|------|----------------------------|
| | GP-A | GP-B | |
| No. of plants planted | 1220 | 1224 | 308 |
| No. of plants established | 1144 | 1061 | 251 |
| Percent established | 93.8 | 86.7 | 81.5 |
| Avg. vigor July-Aug. ² | 6.00 | 5.90 | 3.60 |
| Root rot--percent of plants ³ | | | |
| Free or slight infection | 22 | 21 | 2 |
| Moderate infection | 37 | 41 | 19 |
| Severe infection | 41 | 38 | 79 |

¹ Equal numbers of Viking and Granger plants.

² Estimated vigor July and August second year with 1 = weak to 9 = vigorous.

³ Plants dug and rated for root rot October 7 to 10, 1969.

Severe root rot infection in the field occurs among second year plants when soil temperatures are high along with adequate soil moisture over extended periods of time. However, we have evidence to indicate that infection by secondary organisms may affect root rot severity in some years. We also have considerable evidence to indicate that clean cultivated spaced plants will develop more root rot than plants in a grass sward, due largely to differences in soil temperatures.

The above evaluation was located on a fine sandy loam where root rots have been prevalent in past years. Replicates of rooted cuttings of parent plants in this same area revealed that a number of clones in each gene pool were susceptible to root rots. Fifteen to twenty of the most resistant parent clones in each group are being intercrossed within and between gene pools. Bulk progenies of these three groups of crosses--5A, 5B, and 5AB--will be evaluated as closely spaced plants in a grass sward, along with suitable checks, to determine if we are approaching a satisfactory field level of root rot resistance.

Recent Epiphytotics on Birdsfoot Trefoil and Crownvetch

Stanley A. Ostazeski and Paul R. Henson (Beltsville)

Rhizoctonia aerial blight of birdsfoot trefoil can be a very destructive disease in dense stands during extended periods of wet, humid weather. During the 32-day period, July 19 through August 19, 1969, at Beltsville, Maryland, recorded precipitation for 17 of those days totalled 14.7 inches. On most of the remaining 15 days of this period, the sky was totally and continuously overcast. In a management study of varieties and selections of alfalfa, clovers, birdsfoot trefoil, and other special purpose legumes established this spring at Beltsville, only the birdsfoot trefoil entries were affected by Rhizoctonia aerial blight. Damage was so extensive in most replications that we question whether or not yield data from these entries will be meaningful in light of the original objectives of the experiment.

Recently at Columbia, Missouri, we saw a space-planted nursery of several hundred crownvetch plants which had been eliminated by an unknown disease. This planting had been established in the spring of 1968 and later overseeded with a mixture of bluegrass, orchardgrass, and tall fescue. Growth of the plants had been normal until May of this year. From April 1 to July 12, 29 inches of rain were recorded at Columbia. Most plants failed to resume growth after normal management could be resumed, and eventually died. The roots of specimens we examined on the site were all affected by a watery, brown root rot of unknown origin.

Both of the epiphytotics cited here were associated with above-normal rainfall over an extended period of time.

MINNESOTA

Miscellaneous Forage Legume Research Results

R. G. Robinson (St. Paul)

Sainfoin

Eski sainfoin and Ranger alfalfa were sown with an oat companion crop April 22, 1965, on both a north- and south-facing hillside at Rosemount. Soil was silt loam of pH 7 and low in P, K, and organic matter. Forage yields taken in June 1966-67 averaged 2,893 lb/A for Eski and 2,496 lb/A for Ranger. Protein percentage averaged 15.7 for Eski and 18.0 for Ranger. On these low fertility sites, a small second cutting could have been taken from alfalfa but none from Eski.

Portions of the plots left for seed production did not produce enough to be worth harvesting. However, an adjacent plot of O. transcaucasia, P.I. 228,154, produced a small seed crop each year (384 lb/A in 1966). All sainfoin, whether previously harvested or not, was gone in 1969, whereas a stand of Ranger alfalfa remained.

Common vetch

Prior to 1968, Warrior produced higher seed yields than most P.I. and other introductions tested. Data from a trial sown on March 29, 1968 follows:

| Variety | Date Mature | Seed/A Lb. |
|--------------|-------------|---------------|
| Warrior | 7/29 | 626 |
| P.I. 220,893 | 8/8 | 281 |
| P.I. 220,906 | 8/8 | 678 |
| Mich 59-208 | 8/10 | 702 |
| Mich 59-224 | 8/9 | 859 |
| LSD (5%) | | 218 |

Lupine

During the past 15 years, several lupine trials conducted at Rosemount and in southwestern and northeastern Minnesota showed that Rhizoctonia was the major factor preventing economic yields.

Crownvetch

Publication--"Crownvetch" Minn. Sci. 25(2):19-20, 1969.

Fababeans

Publication--"Fababeans--a new crop for Minnesota?" Minn. Agr. Exp. Sta. Misc. Rep. 83:1-8, 1968.

MONTANA

Selection for Regrowth in Sainfoin

R. H. Delaney and A. E. Carleton (Bozeman)

Sainfoin (Onobrychis viciaefolia Scop.) is rapidly becoming an economically important forage crop in Montana and adjacent states. The major reasons for this rapid increase are: (1) no bloat, (2) no alfalfa weevil damage, (3) ease of establishment, (4) good forage yields, and (5) quality hay and pasture. Most acreage (approximately 12,000 acres) is planted to the Montana-developed variety 'Eski'. Eski sainfoin can best be described as a one-cut type where 2/3 to 3/4 of the total season yield is produced in the first harvest. This type does quite well under one cut dryland hay conditions. However, where two or three good hay harvests are possible or where the forage is used as pasture, Eski has not performed as well as alfalfa. This has been attributed to its inherent lack of regrowth.

A selection program was begun in 1966 to obtain sainfoin lines with rapid recovery after clipping. Over 400 sainfoin introductions were evaluated for regrowth and 17 lines were selected (table 1). Most of the lines came from Iran at various elevations and latitudes. Regrowth was measured 3 weeks after the first and second harvest in 1966. All of the lines had more regrowth than Eski. Seed was produced on these lines while the remaining entries in this nursery were not allowed to flower in 1966. Seed obtained in the above manner was used to establish two forage trials in 1967. Forage yields were taken at Huntley and Bozeman in 1967 and 1968 (tables 2, 3, 4, and 5). Data in these tables show that the selected lines have better regrowth than Eski. Sixteen of the original lines have been bulked, and this bulked population of regrowth sainfoin is currently under evaluation at six locations in Montana.

Table 1. Origin, winterhardiness, and regrowth evaluation of 17 selected plant introductions and Eski.

| <u>1/</u> Entry | P.I. no. | Origin | Elevation collected ft. | North latitude collected o' | Regrowth 3 wks after harvest ^{2/} | | Winter- hardiness 3/ % survival |
|--------------------|-------------|---------|-------------------------------|--------------------------------------|---|----------------|--|
| | | | | | 1st cut in. | 2nd cut in. | |
| 1 | 227,375 | Iran | 500 | 32.03 | 20 | 15 | 90 |
| 2 | 212,241 | Armenia | --- | --- | 14 | 8 | 87 |
| 3 | 223,389 | Iran | 5,000 | 38.15 | 16 | 10 | 72 |
| 4 | 227,038 | Iran | 5,200 | 29.38 | 18 | 13 | 86 |
| 5 | 227,373 | Iran | 7,200 | --- | 20 | 10 | 68 |
| 6 | 228,289 | Iran | 6,000 | 33.23 | 18 | 16 | 67 |
| 7 | 228,352 | Iran | 8,000 | 32.42 | 17 | 10 | -- |
| 8 | 228,402 | Iran | 7,500 | 32.20 | 16 | 10 | 68 |
| 9 | 229,612 | Iran | 8,500 | 35.18 | 15 | 10 | 69 |
| 10 | 236,486 | Turkey | --- | --- | 10 | 11 | 61 |
| 11 | 239,957 | Iran | --- | --- | 20 | 16 | 60 |
| 12 | 239,958 | Iran | 6,000 | 33.23 | 18 | 16 | 69 |
| 13 | 239,959 | Iran | 3,600 | 26.49 | 19 | 14 | 77 |
| 14 | 239,960 | Iran | 4,900 | 35.44 | 20 | 18 | 78 |
| 15 | 243,226 | Iran | 4,950 | 38.05 | 14 | 12 | 81 |
| 16 | 243,227 | Iran | 4,950 | 38.05 | 14 | 12 | 85 |
| 17 | 250,024 | Iran | 500 | 32.30 | 19 | 16 | 80 |
| Eski | | Turkey | 3,000 | 39.46 | 8 | 5 | 83 |

1/ These entry numbers will replace the P.I. numbers throughout this paper.

2/ Data collected at Bozeman, Montana.

3/ Data collected at Moccasin, Montana.

Table 2. Yield and height measurements of 16 sainfoin regrowth lines, Eski, and two alfalfa varieties the first harvest year at Huntley, Montana (1967). ^{1/}

| Entry ^{2/} | First Cutting 7/26/67 | Second Cutting 9/20/67 | Total | Regrowth 8/19/67 | Regrowth 9/3/67 |
|---------------------|-----------------------------|------------------------------|---------|---------------------|--------------------|
| | (g) | (g) | (g) | (in) | (in) |
| Haymor | 132.7a | 156.4a | 287.7a | 14.4* | 17.6* |
| 13 | 88.5c | 158.4a | 247.5ab | 13.2* | 16.6* |
| 8 | 92.5bc | 153.1abc | 245.6ab | 13.4* | 18.0* |
| 14 | 83.7c | 155.7ab | 243.2ab | 13.4* | 17.2* |
| Ladak | 114.8ab | 126.5abcd | 240.8ab | 13.0* | 14.2* |
| 6 | 83.6c | 148.5abc | 232.5b | 12.4* | 16.0* |
| 5 | 80.8c | 147.0abc | 226.8b | 13.0* | 16.2* |
| 10 | 80.7c | 142.abc | 223.3b | 11.8* | 15.8* |
| 16 | 80.2c | 139.3abcd | 220.8b | 13.0* | 16.0* |
| 4 | 84.3c | 134.8abcd | 219.8b | 12.4* | 15.8* |
| 11 | 74.2c | 140.8abc | 214.9b | 11.8* | 16.0* |
| 15 | 79.4c | 132.6abcd | 213.2b | 11.0* | 12.4* |
| 2 | 84.2c | 126.3abcd | 209.9b | 10.4* | 11.0 |
| 3 | 72.7c | 131.0abcd | 205.6b | 11.0* | 13.8* |
| 12 | 69.7c | 135.3abcd | 204.5b | 12.2* | 15.6* |
| 9 | 72.8c | 126.9abcd | 199.7b | 10.8* | 13.6* |
| 1 | 73.2c | 120.3bcd | 193.8b | 11.0* | 13.0* |
| 17 | 72.1c | 118.9cd | 190.4b | 11.4* | 14.2* |
| Eski | 86.0c | 103.4d | 187.8b | 8.6 | 8.8 |
| s \bar{y} | 8.50 | 10.50 | 17.37 | | |
| cv | 22.20 | 17.07 | 17.42 | 10.60 | 13.72 |
| LSD .05 | 23.6 | 29.4 | 48.6 | 1.3 | 2.5 |

^{1/}Values followed by the same letter are not significantly different at P=.05. The asterisk (*) indicates values significantly different from Eski at P=.05.

^{2/}Entries ranked according to 1967 total season yield.

Table 3. Yield, height and spring growth measurements of 16 sainfoin regrowth lines, Eski, and two alfalfa varieties the second harvest year at Huntley, Montana (1968).^{1/}

| Entry ^{2/} | First Cutting 6/12/68 | Second Cutting 7/31/68 | Third Cutting 9/11/68 | Total | Regrowth 6/29/68 | Spring Growth ^{3/} 4/19/68 |
|---------------------|-----------------------------|------------------------------|-----------------------------|----------|---------------------|---|
| | (g) | (g) | (g) | (g) | (in) | |
| 13 | 319.1ab | 180.5abc | 184.3a | 684.0a | 10.0* | 1.9 |
| 14 | 316.8ab | 179.8abc | 173.1ab | 669.8ab | 10.6* | 1.6 |
| 6 | 307.5abc | 193.0ab | 135.8bcdef | 635.5abc | 10.6* | 1.4 |
| 11 | 294.3abcd | 176.5abc | 152.4abcde | 623.2abc | 10.2* | 1.6 |
| 10 | 330.4a | 149.0cde | 122.9cdef | 602.4abc | 7.8* | 1.6 |
| 8 | 249.7de | 108.6ef | 167.0abc | 597.3abc | 10.4* | 1.6 |
| Haymor | 213.2e | 213.5a | 166.1abcd | 592.6abc | 8.2* | -- |
| 15 | 311.1ab | 155.7bcd | 120.0def | 587.0abc | 9.4* | .8 |
| 3 | 300.3abcd | 164.1bcd | 121.7cdef | 586.1abc | 8.4* | .8 |
| 16 | 307.6abc | 145.0cde | 132.2bcdef | 584.9abc | 9.2* | .6 |
| 4 | 293.2abcd | 153.9bcd | 128.3bcdef | 575.5abc | 9.0* | 1.4 |
| 12 | 295.1abcd | 133.2def | 132.1bcdef | 560.3abc | 9.4* | 2.0 |
| 5 | 274.0abcd | 146.3cde | 130.3bcdef | 550.6bc | 8.6* | .2 |
| Ladak | 215.7e | 195.5ab | 135.1bcdef | 546.2bc | 6.4* | -- |
| 17 | 268.7bcd | 157.9bcd | 118.4ef | 545.0bc | 9.6* | 1.4 |
| 2 | 303.5abcd | 123.4def | 98.4f | 525.2c | 6.8* | .2 |
| 9 | 268.8bcd | 133.7def | 122.2cdef | 524.8c | 8.8* | 1.2 |
| 1 | 275.4abcd | 146.0cde | 101.1f | 522.6c | 9.6* | 1.2 |
| Eski | 253.8cde | 103.8f | 48.1g | 405.5d | 4.0 | -.6 |
| \bar{y} | 16.92 | 12.79 | 13.80 | 37.02 | | |
| cv | 13.23 | 18.23 | 23.40 | 14.30 | 10.80 | |
| LSD .05 | 47.3 | 35.7 | 38.6 | 103.5 | 1.2 | |

^{1/} Values followed by the same letter are not significantly different at P=.05. The asterisk (*) indicates values significantly different from Eski at P=.05.

^{2/} Entries ranked according to 1968 total season yield.

^{3/} 2=much superior to Eski buffer rows

1=superior to Eski buffer rows

0=same as Eski buffer rows

-1=inferior to Eski buffer rows

Table 4. Yield and height measurements of 17 sainfoin regrowth lines, Eski, and two alfalfa varieties the first harvest year at Bozeman, Montana (1967). ^{1/}

| Entry ^{2/} | First Cutting 7/25/67 | Second Cutting 8/29/67 | Total Season | Regrowth 8/19/67 |
|---------------------|-----------------------------|------------------------------|-----------------|---------------------|
| | (g) | (g) | (g) | (in) |
| 3 | 119.6a | 162.8ab | 282.4a | 16.8* |
| 14 | 104.4abcd | 171.4a | 275.8ab | 21.0* |
| 9 | 110.0abc | 161.3ab | 271.3abc | 17.8* |
| 4 | 110.0abc | 160.7ab | 270.7abcd | 19.0* |
| 11 | 107.0abc | 163.0ab | 270.0abcd | 19.8* |
| 12 | 104.4abcd | 156.0abc | 260.5abcde | 21.4* |
| 16 | 103.6abcd | 156.4abc | 260.0abcde | 19.0* |
| 15 | 102.9abcd | 156.0abc | 258.9abcde | 18.2* |
| 10 | 104.4abcd | 151.1abc | 255.5abcdef | 19.2* |
| 13 | 102.7abcd | 150.3abc | 253.0abcdef | 20.4* |
| 2 | 113.6ab | 133.5bcd | 247.1abcdefg | 14.2* |
| 1 | 99.7abcd | 145.6abcd | 245.3abcdefg | 19.8* |
| 6 | 95.7bcd | 143.7abcd | 239.4bcdefgh | 20.0* |
| 8 | 91.6bcd | 146.1abcd | 237.8cdefgh | 20.0* |
| 17 | 93.9bcd | 139.6abcd | 233.6defghi | 20.4* |
| Ladak | 97.5abcd | 130.1bcde | 227.6efghi | 17.2* |
| 5 | 82.8d | 138.4abcd | 221.2fghi | 17.4* |
| 7 | 88.4cd | 124.4cde | 212.8ghi | 19.2* |
| Haymor | 92.4bcd | 112.3de | 204.7hi | 18.8* |
| Eski | 101.0abcd | 100.8e | 201.8i | 10.0 |
| \bar{y} | 6.78 | 10.23 | 11.12 | |
| cv | 14.96 | 15.76 | 14.26 | 7.8 |
| LSD .05 | 19.0 | 28.8 | 44.0 | 1.8 |

^{1/}Values followed by the same letter are not significantly different at P=.05. The asterisk (*) indicates values significantly different from Eski at P=.05.

^{2/}Entries ranked according to 1967 total season yield.

Table 5. Yield and height measurements of 17 sainfoin regrowth lines, Eski, and two alfalfa varieties the second harvest year at Bozeman, Montana (1968). ^{1/}

| Entry ^{2/} | First Cutting 7/2/68 | Second Cutting 8/8/68 | Total Season | Regrowth 7/19/68 | Regrowth ^{3/} 9/18/68 |
|---------------------|----------------------------|-----------------------------|-----------------|---------------------|-----------------------------------|
| | (g) | (g) | (g) | (in) | (in) |
| 16 | 383.2ab | 165.abc | 548.4a | 9.8* | 7.2* |
| 4 | 372.0abc | 151.3abc | 523.3ab | 9.2* | 7.6* |
| 14 | 333.4abcde | 189.3a | 522.7ab | 11.6* | 8.8* |
| 3 | 355.0abcd | 161.9abc | 516.9ab | 7.8* | 5.7* |
| 2 | 372.1abc | 144.9bcd | 516.9ab | 8.0* | 5.0* |
| 15 | 345.6abcde | 165.abc | 511.4ab | 10.8* | 7.7* |
| 13 | 328.6abcde | 171.0ab | 499.6ab | 11.0* | 8.9* |
| 10 | 354.0abcd | 144.9bcd | 498.9ab | 8.2* | 5.8* |
| Eski | 387.2a | 108.6d | 495.8abc | 3.8 | 3.1 |
| 1 | 328.abcde | 155.4abc | 484.1abcd | 11.0* | 7.7* |
| 7 | 310.6abcde | 169.7ab | 480.3abcd | 10.8* | 8.7* |
| 11 | 302.8bcde | 165.8abc | 468.6bcd | 11.4* | 7.9* |
| 8 | 296.2cde | 165.8abc | 462.3bcd | 10.8* | 8.1* |
| 17 | 300.8cde | 155.3abc | 456.1bcd | 11.2* | 7.6* |
| 9 | 309.0abcde | 143.6bcd | 452.6bcd | 9.0* | 6.2* |
| 12 | 287.8de | 157.9abc | 445.7bcd | 11.4* | 8.3* |
| 6 | 268.6ef | 151.3abc | 420.0cde | 10.6* | 8.2* |
| 5 | 287.6de | 126.6cd | 414.2def | 10.4* | 6.3* |
| Haymor | 202.8f | 148.7abc | 351.5ef | 11.0* | 12.0* |
| Ladak | 213.4f | 133.6bcd | 347.0f | 5.6* | 8.1* |
| s \bar{y} | 24.13 | 12.28 | 23.51 | | |
| cv | 17.02 | 17.84 | 15.79 | 14.48 | 3.4 |
| LSD .05 | 67.9 | 34.6 | 93.6 | 1.8 | 1.6 |

^{1/} Values followed by the same letter are not significantly different at P=.05. The asterisk (*) indicates values significantly different from Eski at P=.05.

^{2/} Entries ranked according to 1968 total season yield.

^{3/} Aftermath at killing frost. Not included in total season yield.

Table 1 shows that it was possible to select for discoloration. Germination percentage was closely associated with discoloration, with highest germinations obtained for fully and partially discolored seeds. Plant #11(4), from P.I. 135,142, demonstrated that a plant arising from normal non-discolored seed can produce discolored seed. Plants developed from fully discolored seed produced both normal and discolored seed. Since all seed was produced under open-pollination, no genetic interpretations can be drawn from the discoloration frequencies.

In 1968, only four plants which had produced a high frequency of discolored seed with high germination were allowed to flower, while the other 9 plants in the 13-plant block established in 1967 were kept from flowering by frequent clippings. This allowed production of seed where all gametes came from plants with known high frequency of discolored seed. However, each genotype is represented by only one plant, and it could be concluded that some form of pollination other than random may have occurred among these 4 plants.

Seed was harvested from these 4 plants in 1968. A sample of 400 seed was classified for discoloration and germination. A comparison of the 1967 and 1968 discoloration frequency and average germination is given in table 2.

Table 2. Classification of seed into discoloration classes and average germination of seed harvested from 4 selected clones for 2 years.

| Clone | 1967 ^{1/} | | | | 1968 ^{2/} | | | |
|---------|--------------------|--------------|-------------|---------------|--------------------|--------------|-------------|---------------|
| | % of classes | | | % | % of classes | | | % |
| | Full | Par- tial | Nor- mal | Avg. Germ. | Full | Par- tial | Nor- mal | Avg. Germ. |
| 4-14(1) | 48.9 | 30.9 | 20.2 | 35.0 | 15.7 | 15.7 | 68.6 | 22.0 |
| 4-14(5) | 2.1 | 38.9 | 59.0 | 18.9 | 13.3 | 27.7 | 59.0 | 13.0 |
| 4-14(6) | 34.4 | 46.9 | 17.5 | 52.8 | 21.3 | 54.7 | 24.0 | 42.0 |
| 4-14(8) | 35.2 | 48.8 | 16.6 | 65.0 | 27.3 | 53.7 | 19.0 | 44.0 |

^{1/} Seed produced under open-pollination of all clones in breeding block.

^{2/} Seed produced under restricted pollination with only 4 selected clones allowed to intercross.

The relative rank of average germination of the four plants was the same in both years. However, there was considerable variation among plants in the production of discolored seed when both years are considered. The elimination of pollen contributed by non-discolored plants in 1968 did not increase the percentage of discolored seed. Germination was lower in 1968 than 1967; however, less than optimum germination temperatures were used in 1968, while the optimum temperature of 15 to 25 C was used for germination in 1967.

An open-pollinated progeny nursery was established in 1968 from full and partially discolored seed produced in 1967 from the 4 selected clones (table 2). Seed was harvested from these open-pollinated progeny in 1968. A sample of 400 seed was classified for discoloration and germinated. Average discoloration frequencies and germination percentages for all progeny of each selected clone are given in table 3.

Table 3. Average discoloration percentages and germination of open-pollinated progeny for 4 clones selected in 1967.

| Clone | % of classes | | | % Germ. | No. progeny plants |
|---------|--------------|---------|--------|---------|--------------------|
| | Full | Partial | Normal | | |
| 4-14(1) | 46.6 | 8.6 | 46.8 | 20.9 | 23 |
| 4-14(5) | 52.7 | 3.3 | 39.0 | 16.3 | 22 |
| 4-14(6) | 53.3 | 15.4 | 31.3 | 30.9 | 48 |
| 4-14(8) | 50.1 | 12.1 | 37.8 | 28.0 | 37 |

Some plants among the open-pollinated progeny of a selected clone produced all normal seed, while others produced a high frequency of discolored seed. However, there was a tendency for clones with high germination to produce progeny with high germination. If 30% germination is set as the minimum level of germination acceptable, then clone 4-14(1), 4-14(5), 4-14(6), and 4-14(8) had 30, 18, 46, and 41% of their respective progeny above the minimum. This shows that clones 4-14(6) and 4-14(8), which had the highest germination, also produced the highest portion of superior progeny. The highest germinating progeny (over 60% germination) were also found in these two clones.

The results obtained so far indicate that germination of cicer milkvetch can be increased by selection for discolored seed. The exact Mendelian inheritance of genes controlling discoloration is not as important now as selection and development of a cicer milkvetch variety which will germinate at a high level and produce good stands. Therefore, little effort has been placed on making specific crosses to determine the inheritance of this factor.

In preliminary studies we have been unable to determine the cause of discoloration. Bacterial and fungal isolations made from mature discolored and normal seeds have been identical. Isolations from immature seeds, made when the discolored sections of the seed appeared as wet lesions, were also negative. Therefore, if the causal agent is a pathogen, it has not been found. Other possible causes for discolored seeds are under investigation.

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4. Qualls, Mickey and C. S. Cooper. Germination, growth and respiration rates of birdsfoot trefoil at three temperatures during early non-photosynthetic stages of development. Crop Sci. 8:758-759. 1968.
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NEW YORK

Winter Survival and Spring Recovery
of Clover and Trefoil Introductions

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Red Clover Introductions

Red clover introductions planted in rod rows in 1968 and rated good to excellent in both percentage winter survival and spring recovery on May 12, 1969, are as follows: P.I. 307948 (Spain), P.I. 310460 (Switzerland), P.I. 310462 (Switzerland), P.I. 310464 (Switzerland), P.I. 311489 (Spain), P.I. 314937 (USSR), P.I. 315504 (USSR), P.I. 315505 (USSR), P.I. 315511 (USSR), P.I. 315514 (USSR), P.I. 315520 (USSR), P.I. 315525 (USSR), P.I. 315527 (USSR), P.I. 315537 (USSR), P.I. 291809 (USA), P.I. 291811 (USA), P.I. 293685 (Germany), P.I. 302972 (Spain), P.I. 325497 (USSR).

The above red clover introductions, having shown good winter survival and spring recovery at the Plant Introduction Station, Geneva, should be further evaluated for agronomic characters and forage yield by cooperators in the northeast region.

White Clover Introductions

The following white clover introductions were rated good to excellent in both percentage winter survival and spring recovery at the Plant Introduction Station, Geneva, on May 12, 1969 (planted in rod rows in the spring of 1968): P.I. 184937 (The Netherlands), P.I. 314122 (USSR), P.I. 314343 (USSR), P.I. 314344 (USSR), P.I. 314588 (USSR), P.I. 314763 (USSR), P.I. 314764 (USSR), P.I. 315541 (USSR), P.I. 315543 (USSR), P.I. 315544 (USSR), P.I. 108722 (USSR), P.I. 204512 (Turkey), P.I. 217444 (Italy), P.I. 246751 (Spain).

The above white clovers, having rated better than satisfactory for percentage winter survival and spring recovery at the Plant Introduction Station, Geneva, should be further tested for agronomic characters and forage yield by cooperators in the Northeast.

Strawberry Clover Introductions

In recent years, introductions of strawberry clover (Trifolium fragiferum) have been used in soil conservation. The following introductions of strawberry clover, planted in rod rows in the spring of 1968, were rated good to excellent for both percentage winter survival and spring recovery at the Plant Introduction Station, Geneva, on May 12, 1969: P.I. 284264 (Australia), P.I. 284267 (Australia), P.I. 314118 (USSR), P.I. 314755 (USSR), P.I. 172475 (Turkey), P.I. 198968 (Cyprus), P.I. 210087 (Australia).

Introductions of Other Perennial Clover Species

The following introductions of other perennial species of Trifolium rated good to excellent in both percentage winter survival and spring recovery on May 12, 1969, in a rod-row planting made in the spring of 1968.

- T. alpestre: P.I. 325479 (USSR), P.I. 325480 (USSR),
P.I. 325481 (USSR)
- T. ambiguum: P.I. 238154 (Turkey), P.I. 325484 (USSR),
P.I. 325486 (USSR), P.I. 325487 (USSR), P.I. 325488 (USSR),
P.I. 325489 (USSR), P.I. 325490 (USSR)
- T. canescens: P.I. 325493 (USSR)
- T. medium: P.I. 317339 (USA), P.I. 325498 (USSR), P.I. 325499
(USSR), P.I. 253202 (Yugoslavia)
- T. montanum: P.I. 234912 (Switzerland)
- T. fragiferum: P.I. 325500 (USSR)
- T. rubens: P.I. 325507 (USSR)
- T. species: P.I. 206480 (Turkey), P.I. 206484 (Turkey)

The above introductions of miscellaneous species of Trifolium should be further tested by cooperators in the Northeast.

Trefoil Introductions

The following introductions of trefoil (Lotus corniculatus) rated good to excellent for both percentage winter survival and spring recovery on May 12, 1969. (All are being grown in rod rows from a planting set out in the spring of 1968): P.I. 290375 (Hungary), P.I. 315082 (USSR), P.I. 315450 (USSR), P.I. 315452 (USSR), P.I. 315454 (USSR), P.I. 315455 (USSR), P.I. 316271* (Australia), P.I. 260692 (Italy).

The above introductions of trefoil, L. corniculatus, should be further tested for agronomic characters and for forage yield by cooperators in the Northeast.

The following introductions of other Lotus species rated good to excellent in both percentage winter survival and spring recovery on May 12, 1969:

- L. pedunculatus: P.I. 251148 (Yugoslavia)
- L. tenuis: P.I. 316270 (Australia)
- L. angustissimus: P.I. 206895 (Turkey)
- L. caucasicus: P.I. 314090 (USSR), P.I. 314535 (USSR),
P.I. 315449 (USSR)
- L. species: P.I. 319021 (Spain)

* P.I. 316271 is L. corniculatus spp. presslii.

Crownvetch Seed Production

C. L. Williams (Big Flats)

One of the greatest problems in producing seed of crownvetch in the Northeast is that of fall plant regrowth. This is caused primarily by cool temperatures and rainfall. Preliminary trials indicated this problem could be controlled to a large extent by the use of chemicals which act as desiccants and/or defoliants. In order that trials might be conducted on a field-scale basis, a new planting of crownvetch was made in 1967. Rows were seeded 126 inches apart to facilitate spraying and harvesting.

In 1968, plant regrowth began about August 15 and became a serious problem in the check rows. This can be attributed to rain showers and minimum daily temperatures as low as 38 F during the month of August.

The chemicals were applied August 22 with field spray equipment. The chemicals and their rates of application were as follows:

| | |
|-----------------|----------|
| Paraquat | 2 qt/A |
| Diquat | 2 qt/A |
| Endothal | 1 qt/A |
| Solvent 52 | 50 gal/A |
| Shed-a-leaf "L" | 5 gal/A |

Water was used as a carrier for all chemicals except Solvent 52. The rate of application was 50 gallons of material per acre. The weather was clear at the time of application and the temperature was 86 F. All of the chemicals had a definite drying effect on the plants. As applied in this study, they were ranked in order for:

| <u>Speed of Drying</u> | <u>Overall Benefit in Harvest</u> |
|------------------------|-----------------------------------|
| Paraquat | Diquat |
| Solvent 52 | Solvent 52 |
| Diquat | Paraquat |
| Shed-a-leaf "L" | Shed-a-leaf "L" |
| Endothal | Endothal |

Notes Concerning Each Chemical

Paraquat: Took effect within 4 hours. Was the fastest acting of the group. Burned leaves off within 30 hours. Stems seemed to dry so fast they were tough and most difficult to combine. It is highly possible that a lower rate could be used.

Diquat: Took effect within 4 hours, but three days were required to achieve maximum results.

Endothal: Gave no immediate results. Required 7 days for full effect. Rate should probably be increased by 50%.

Solvent 52: Took effect within 4 hours. Required 48 hours to achieve maximum results. Rate could probably be decreased to 30 gal/A.

Shed-a-leaf "L": Gave no immediate results. Required 5 days for maximum results.

The combine was being used to harvest crownvetch from off-Center seed production fields; therefore, these test plots were not harvested until September 3 and 4.

It is important to note that the chemicals as applied in this study had no effect on seed yield or germination.

This is a progress report; therefore no attempt should be made to reach conclusions from the information presented as to the use and recommendation for these chemicals.

NORTH CAROLINA

Observations on Some Tropical Species of Phaseolus and Stylosanthes

Will A. Cope (Raleigh)

Two species of Phaseolus and 5 species of Stylosanthes made fairly good forage growth as spaced plants in 1968. However, none survived the winter as perennials nor re-established from seed in 1969. None appear to have potential as forage crops in North Carolina.

Seed of 11 introductions representing 5 species of Stylosanthes were received from the Regional Plant Introduction Station, Experiment, Georgia. Two strains of S. humilis and 2 species of Phaseolus, P. atropurpureus (siratro) and P. lathyroides, were received from Dr. Al Kretschmer, Fort Pierce, Florida. Approximately 10 plants each of most accessions were grown in 3.5 x 3.5 ft. spacing in a Norfolk sand 15 miles east of Raleigh. Seed of both Phaseolus species germinated well and seedlings grew rapidly. Field growth appeared adequate for forage production. P. lathyroides flowered in mid-summer and P. atropurpureus in early fall, and each produced a few seed. Neither survived the winter nor re-established as seedlings in the spring of 1969.

Seed of most of the Stylosanthes accessions germinated very slowly and seedling vigor was low. Seed of S. humilis could be dehulled rather easily, and the dehulled seed germinated fairly well; some germinated within a few days, but others remained dormant and germinated over a period of a week or two. Seed of most of the other species were enclosed in pods that were extremely hard and required trimming away with a razor blade. The dehulled seed then germinated over a period of more than a month. S. humilis, S. gracilis, and S. sundaica grew to the size of Korean lespedeza plants. Two plants obtained from the few available seed of S. guyanensis were grown only in the greenhouse and appeared of similar vigor. S. mucronata was slightly less vigorous. Growth habit was spreading to semi-decumbent with thick branching for all except S. juncea, which was upright and sparsely branched. S. juncea was the only one to flower well; others flowered little or not at all. None of the plants survived the winter, and no reseedling occurred in 1969.

Low Tannin Sericea More Digestible Than Other Selections

Will A. Cope and Joseph C. Burns (Raleigh)

Forage samples were analyzed from two harvests at two location. Four strains being selected for leafiness and fine stems were only slightly more digestible than four unselected strains. One low tannin strain of sericea was 25% more digestible than eight other strains.

Samples of the nine strains were taken from the first two hay cuts of a strain test on a fertile Cecil clay loam at Raleigh and from a light Norfolk sand at Clayton 15 miles east of Raleigh. The forage was dried in a forage dryer with circulating hot air at approximately 65 C. Three reps were analyzed for the first harvest and four for the second. The dried forage was ground through a 20-mesh screen. The in vitro method used was the 2-stage digestion, 48 hours with rumen fluid and 24 hours with pepsin.

Results are shown in table 1, and mean forage yields are included. The selected strains were only slightly higher in digestibility than unselected strains. However, the low tannin strain was 9% higher in dry matter disappearance which is a 25% superiority over the average of the other eight. Tannin content of the low tannin strain, although not measured in this test, is approximately one-third that of common sericea.

The first harvest at each location was made rather late as shown by the high forage yield. Late maturity of the forage from Norfolk soil is reflected in relatively low mean digestibility for the test--32.6%. In contrast, digestibility for first harvest on Cecil soil was 40% even though forage yield for the test was considerably higher. The reason for higher digestibility of first cut sericea on Cecil soil is not known, but could possibly be related to higher fertility level and consequent rapid growth rate of sericea. There was little difference in digestibility of the second-cut forage at the two locations.

This study indicates that digestibility of sericea forage is influenced to a greater degree by tannin content than by morphological type. Selection for both characters should produce a variety with forage quality greatly superior to that of common sericea.

Table 1. Forage digestibility and yield of unselected sericea strains, strains selected for forage quality, and one low tannin strain for two harvests at two locations. IVDMD expressed as percent dry matter disappearance.

| Strain type and number | IVDMD, 1968 | | | | Grand mean | Yield, T/A | | | |
|---------------------------|-------------|------|---------|------|---------------|------------|------|---------|------|
| | Raleigh | | Clayton | | | Raleigh | | Clayton | |
| | 5/29 | 7/9 | 7/31 | 7/8 | | 5/29 | 7/9 | 5/31 | 7/8 |
| Unselected, 4 | 38.7 | 35.3 | 30.5 | 34.9 | 34.6 | 1.74 | 0.75 | 1.28 | 0.93 |
| Selected, 4 | 40.1 | 36.3 | 31.8 | 34.8 | 35.7 | 1.76 | 0.78 | 1.30 | 0.94 |
| Low tannin, 1 | 44.5 | 38.6 | 44.1 | 48.9 | 44.0 | 1.66 | 0.63 | 1.02 | 0.75 |
| Test mean, 9 | 40.0 | 36.1 | 32.6 | 36.4 | 36.1 | 1.73 | 0.73 | 1.23 | 0.91 |

OHIO

Birdsfoot Trefoil and Crownvetch Studies

R. W. Van Keuren (Wooster)

1. Variety Trials

Table 1. Crownvetch variety trial, 1968, Wooster. Seeded April 1963. Average 3 replications.

| Variety | T/A of Dry Matter | | | Yield as hay at 12% moisture |
|------------|-------------------|------|-------|---------------------------------------|
| | 6/12 | 9/3 | Total | |
| Penngift | 2.56 | 1.98 | 4.54 | 5.16 |
| Chemung | 2.56 | 1.53 | 4.09 | 4.65 |
| Emerald | 2.36 | 1.37 | 3.73 | 4.24 |
| LSD at .05 | | | N.S. | |
| CV - % | | | 6.47 | |

Comment: This trial has bluegrass and orchardgrass encroaching and has been sprayed with dalapon to determine the value of this herbicide in eliminating grasses in crownvetch.

Table 2. Crownvetch variety trial, 1968, Wooster. Seeded April 11, 1968, using Eptam for weed control. Average 4 replications.

| Variety | T/A of Dry Matter | | | Yield as hay at 12% moisture |
|----------------|-------------------|------|-------|---------------------------------------|
| | 7/5 | 9/3 | Total | |
| Penngift | 1.49 | 1.12 | 2.61 | 2.97 |
| Emerald | 1.42 | 1.07 | 2.49 | 2.83 |
| Chemung | 1.39 | .89 | 2.28 | 2.59 |
| Exp. low-crown | 1.57 | .64 | 2.21 | 2.51 |
| LSD at .05 | | | N.S. | |
| CV - % | | | 19.64 | |

Comment: This trial indicates the value of speed of control in establishing crownvetch. It also shows the gains that can be obtained establishment year from crownvetch with early seeding and with vegetative competition eliminated. Band seeding with press wheels was used.

Table 3. Birdsfoot trefoil variety trial, 1968, Wooster. Sown April 20, 1967. Average 4 replications.

| Variety | T/A of Dry Matter | | | | Yield as hay at 12% moisture |
|------------|-------------------|------|------|-------|---------------------------------------|
| | 5/29 | 7/5 | 9/5 | Total | |
| Viking | 1.60 | 1.38 | 1.22 | 4.20 | 4.77 |
| Leo | 1.67 | 1.35 | 1.13 | 4.15 | 4.72 |
| Mansfield | 1.47 | 1.27 | 1.29 | 4.03 | 4.56 |
| Dawn | 1.59 | 1.17 | 1.19 | 3.95 | 4.49 |
| Granger | 1.30 | 1.38 | 1.25 | 3.93 | 4.47 |
| Cascade | 1.36 | 1.29 | 1.16 | 3.81 | 4.32 |
| Empire | 1.38 | 1.30 | .82 | 3.50 | 3.98 |
| LSD at .05 | | | | .38 | |
| CV - % | | | | 11.80 | |

2. Seeding Birdsfoot Trefoil into Established Grass Sod

Studies are under way on seeding birdsfoot trefoil into established grass sod as a method of improving pastures where existing grass stand is good but no legume is present. Spraying narrow bands of paraquat, dalapon, and the two herbicides, together with drilling the trefoil with a grassland drill has been very promising. Spray bands of 3 and 6 inches were used with 10-inch drill spacings. Trefoil generally required 2 years to develop a stand of 50% ground cover or more in vigorous bluegrass stands. All herbicide treatments were similarly effective.

Publications:

Van Keuren, R. W., R. R. Davis, D. S. Bell, and E. W. Klosterman. 1969. Effect of grazing management on animal production from birdsfoot trefoil pastures. Agron. J. 61:422-425.

OREGON

Trefoil Seed Production

Stanley L. Swanson (Corvallis)

Seed yield and test data for three trefoils being grown at the Corvallis, Oregon, Plant Materials Center have provided additional information relative to the new harvesting method now in use. The 1968 season was the second during which small asphalt laminated jute "tarps" were used for field drying of the three trefoil species. The tarps are actually bags which were opened up to form aprons 56 x 60 inches in size.

Separate clean seed yields were recorded from both the threshed material forked from the aprons and from the residue remaining on the aprons. The shattered seed caught by the aprons didn't require threshing. In 1968, the following yields were obtained.

Cascade birdsfoot trefoil, Lotus corniculatus: 273 lb/A, with 73% obtained from the aprons or tarps.

Los Banos narrowleaf trefoil, L. tenuis: 288 lb/A, with 54% from the aprons.

Big trefoil P-15553, L. pedunculatus: 513 lb/A, with 20% from the aprons.

In addition to the impressive amounts of trefoil caught by the jute aprons, seed quality was excellent. Also, hard seed percentages appeared closely related to whether or not seed was threshed. Cascade trefoil seed from both sources was tested separately in 1968 with the following results.

Tarp seed (not threshed): 605 lbs, total yield; purity 99.97%; germination 25% + 74% hard seed = 99% total.

Threshed seed: 222 lbs, total yield; purity 99.94%; germination 68% + 24% hard seed = 92% total.

Both sources of seed of the other two trefoils were mixed prior to being sent to the seed testing lab. They tested as follows:

Los Banos trefoil: 657 lbs, total yield; purity 99.97%; germination 32% + 56% hard seed = 88% total.

Big trefoil: 415 lbs, total yield; purity 99.17%; germination 65% + 31% hard seed = 96% total.

SOUTH CAROLINA

Breeding and Genetics, Diseases, Quality and Varietal Evaluation,
and Culture and Physiology of Perennial Species of Clovers
for Hay, Pasture, Seed, and Soil Improvement

Pryce B. Gibson (Clemson)

Observations on Trifolium uniflorum L.

Interest in this species is based upon Pandey's report (J. Hered. 48:278-281, 1957) of a self-compatible hybrid between this species and T. repens.

Fourteen plants were obtained from planting all the seed obtained as P.I. 330361. The seed were received in the summer of 1968. The plants obtained are the first plants of this species we have seen.

Preliminary observations indicate that there is considerable variation in self-compatibility among plants. Also, in preliminary attempts to repeat the cross reported by Pandey, we have failed to obtain a viable seed.

Differences Between Seedling Plants from Reciprocal Crosses Between Trifolium repens and T. occidentale.

Six unrelated T. repens clones were used as both pollen and seed parents in crosses with colchicine-induced tetraploid of T. occidentale. Crosses using T. repens as the seed parent gave a higher seed set per floret pollinated, a higher percent germination of seed, and fewer chlorophyll-deficient seedlings. Pollinating 611 T. repens florets resulted in 650 seed and 530 seedlings, of which only 29 exhibited chlorophyll deficiencies. Chlorophyll deficiencies of these 29 seedlings were limited to sectors of leaflets and in no case appeared to be lethal. Pollinating 671 T. occidentale florets resulted in 321 seed and 243 seedlings, of which 210 exhibited chlorophyll deficiencies. Several of these chlorophyll-deficient seedlings died. Some seedlings possessed green cotyledons but only albino true leaves. A few apparently albino seedlings produced green sectors which grew into green plants. Several yellow or light green seedlings grew into mature plants. The chlorophyll-deficient seedlings obtained from seed resulting from the use of pollen from one T. repens clone were mostly yellow or light green contrasted to predominantly albinos and plants with albino sectors obtained from seed that resulted from the use of pollen from other T. repens clones. Apparently, cross ability and compatibility with T. occidentale varies among clones of T. repens. These results of reciprocal differences and differences among clones indicate that in attempting to make a species hybrid involving a highly variable

species such as T. repens reciprocal crosses should be made and a large number of clones should be used in the crosses rather than making many pollinations on one clone.

Species Hybrids.

We have obtained a species hybrid that is very similar to T. repens. This hybrid was obtained by making two crosses.

1. Trifolium nigrescens ($2n = 16$) x T. occidentale ($2n = 32$). This cross is easy to make and, in all plants examined, has resulted in a 24-chromosome triploid.
2. Above triploid x T. occidentale ($2n = 32$). From many pollinations 2 plants were obtained. One is very much like T. repens in morphological characteristics. The somatic chromosome complement is 32 and the plant crosses with T. repens.

Our results with this hybrid and the characteristics of the species involved suggest that T. repens may be, according to Stebbins' terminology, a segmental allopolyploid containing chromosomes from T. occidentale and T. nigrescens, but more from the former.

The relative cross compatibilities of this hybrid are indicated by these results:

| <u>Cross</u> | <u>Florets pollinated</u> | <u>Seed set</u> |
|---|-------------------------------|---------------------------|
| Segmental Poly. x <u>T. occidentale</u> ($2n = 32$) | 199 | 3 plump, 1 shrivelled |
| Segmental Poly. x <u>T. repens</u> ($2n = 32$) | 353 | 13 plump, 1 shrivelled |
| Segmental Poly. x <u>T. repens</u> ($2n = 64$) | 69 | 5 plump |

Publications:

1. Chou, Meei-chih, and Pryce B. Gibson. 1967. Cross-compatibility of Trifolium nigrescens with diploid and tetraploid Trifolium occidentale. Crop Sci. 8:266-267.
2. Gibson, Pryce B. and George Beinhart. 1969. Hybridization of Trifolium occidentale with two other species of clover. J. Hered. 60:93-95.

SOUTH DAKOTA

Legume Species and Variety Trials

M. D. Rumbaugh (Brookings)

Table 1. Average performance of sainfoin and alfalfa at Brookings, S.D., seeded May 1965.

| Variety | Stand 6/5/67 (%) | Dry Forage Yield | | | Seed Yield ^{1/} | | |
|----------------|------------------------|-----------------------|-----------------------|-------------|--------------------------|--------------|--------------|
| | | 1966 3 cuts T/A | 1967 2 cuts T/A | Avg. T/A | 1966 Lb/A | 1967 Lb/A | Avg. Lb/A |
| Eski sainfoin | 58 | 2.06 ± .15 | .98 ± .07 | 1.52 | 988 ± 172 | 599 ± 196 | 794 |
| Vernal alfalfa | 87 | 3.70 .11 | 2.74 ± .10 | 3.22 | 174 ± 43 | 2 ± 1 | 88 |

^{1/} Seed without hulls in 1966 and with hulls in 1967.

Table 2. 1967 Trefoil Variety Test. South Dakota Agricultural Experiment Station.

| | |
|---------------------------------|-------------------------|
| Location: Brookings | Plot size: 4 x 20 ft. |
| Design: Randomized block | Planting date: May 1967 |
| Method of seeding: V-belt drill | Replications: 4 |
| Soil type: Vienna loam | Year: 1968 |

| Entry | <u>Stand</u> | <u>Per Acre</u> |
|-----------------------------|------------------------------|---------------------------------------|
| | <u>Percent</u> 6 - 5 - 68 | <u>Oven Dry Tons</u> 1968 - 2 cuts |
| Dawn | 81 | 1.31 |
| Empire (S.C.S. Mich. 240) | 75 | 1.62 |
| Empire (N.Y. Cert.) | 61 | 1.47 |
| Granger | 21 | .48 |
| Import (Yugosl.) | 25 | .53 |
| Leo | 73 | 1.44 |
| Ia. E-1 | 63 | 1.32 |
| Ia. R-1 | 91 | 1.43 |
| Mo. 10 | 88 | .96 |
| Mo. 110 | 25 | .57 |
| NDL - 45 | 26 | .80 |
| S.D. BFT Cycle II 1963 | 68 | 1.22 |
| MC-H-66 F.C. 39, 448 | 72 | 1.20 |
| MC-F-66 F.C. 39, 449 | 88 | 1.21 |
| V 15 (N.Y.) F.C. 39, 468 | 53 | .91 |
| P-15456 F.C. 39, 471 | 86 | 1.47 |
| N6-128 F.C. 39, 469 | 72 | 1.20 |
| Purdue Syn A F.C. 39, 482 | 20 | .67 |
| Test Mean | 60 | 1.10 |
| ^w (0.05) | 41 | .66 |
| C.V. (%) | 27 | 23 |

Table 3. South Dakota Agricultural Experiment Station.
1967 pasture legume species test.

| | |
|---------------------------------|-------------------------|
| Location: Brookings | Plot size: 4 x 20 ft. |
| Design: Split plot | Planting date: May 1967 |
| Method of seeding: V-belt drill | Replications: 4 |
| Soil type: Vienna loam | Year: 1968 |

| Entry ^{1/} | Legume % Stand 6/5/68 | Oven Dry T/A 2 cuts |
|---------------------------------------|-----------------------------|---------------------------|
| Smooth Bromegrass + Travois alfalfa | 93 | 2.36 |
| Smooth Bromegrass + Eski sainfoin | 83 | 1.33 |
| Smooth Bromegrass + Penngift c.v. | 11 | 1.44 |
| Smooth Bromegrass + Emerald c.v. | 11 | 1.52 |
| Smooth Bromegrass + Chemung c.v. | 10 | 1.49 |
| Smooth Bromegrass + Empire b.f.t. | 16 | 1.77 |
| Smooth Bromegrass + Leo b.f.t. | 16 | 1.76 |
| Smooth Bromegrass + NDL-45 b.f.t. | 6 | 1.36 |
| Smooth Bromegrass + Mich. -240 b.f.t. | 9 | 1.55 |
| Smooth Bromegrass + Dawn b.f.t. | 13 | 1.68 |
| Mean | 27 | 1.63 |
| ^w (0.05) | 12 | .38 |
| C.V. (%) | 17 | 9 |

^{1/} Seeding rates in lbs./acre:

| | |
|-------------|----|
| alfalfa | 12 |
| sainfoin | 18 |
| crown vetch | 12 |
| trefoil | 12 |
| bromegrass | 6 |

Table 4. South Dakota Agricultural Experiment Station
1967 Sainfoin test.

Location: Brookings Plot size: 4 x 20 ft.
Design: Randomized block Planting date: May 1967
Method of seeding: V-belt drill Replications: 4
Soil type: Vienna loam Year: 1968

| | % Stand 6/5/68 | | Oven Dry T/A |
|------------------------------------|-------------------|-------|-----------------|
| | Legume | Grass | 2 cuts |
| <u>Varieties:</u> | | | |
| Eski sainfoin | 93 | | 1.01 |
| Travois alfalfa | 94 | | 2.84 |
| Manchar bromegrass | | 93 | 1.61 |
| Fairway crested wheatgrass | | 89 | .88 |
| Oahe intermediate wheatgrass | | 88 | 1.50 |
| Vinall Russian wildrye | | 32 | .91 |
| <u>Sainfoin Mixtures:</u> | | | |
| Sainfoin + bromegrass | 52 | 90 | 1.82 |
| Sainfoin + crested | 82 | 86 | 1.02 |
| Sainfoin + intermediate wheatgrass | 79 | 84 | 1.40 |
| Sainfoin + wildrye | 79 | 9 | .97 |
| Mean | 73 | 67 | 1.30 |
| <u>Alfalfa Mixtures:</u> | | | |
| Alfalfa + bromegrass | 90 | 90 | 2.71 |
| Alfalfa + crested wheatgrass | 90 | 78 | 2.67 |
| Alfalfa + intermediate wheatgrass | 90 | 89 | 3.92 |
| Alfalfa + wildrye | 91 | 6 | 3.08 |
| Mean | 90 | 66 | 3.09 |
| Test Mean | | | 1.88 |
| $W(0.05)$ | | | 1.51 |
| C.V. (%) | | | 32 |

1/ Seeding rates: Alfalfa 10 g/plot
Sainfoin 20 g/plot
Grasses 10 g/plot
1/2 of above when in mixtures

Table 5. Summary of observations on the 1967 Miscellaneous Legume
Test at Brookings, South Dakota 1967 data.

| Entry | Scores | | Percent bloom 7-27-67 |
|----------------------------|--------|-------|--------------------------|
| | Stand | Vigor | |
| Mesa Gaur | 0.0 | --- | -- |
| Roughpea | 5.0 | 1.5 | 0 |
| Tangier pea | 1.5 | 1.0 | 62 |
| Climax annual lespedeza | 1.0 | 1.5 | 0 |
| Korean annual lespedeza | 1.5 | 1.5 | 0 |
| Serala seresia | 5.0 | 4.5 | 0 |
| Leo birdsfoot trefoil | 1.0 | 1.0 | 60 |
| Rancher sweet blue lupine | 4.5 | 1.0 | 2 |
| Blanco sweet blue lupine | 3.5 | 1.0 | 0 |
| Common bitter blue lupine | 4.5 | 1.0 | 5 |
| Weiko III yellow lupine | 4.0 | 1.0 | 2 |
| Florana annual sweetclover | 1.0 | 1.0 | 5 |
| Hubam annual sweetclover | 2.5 | 1.5 | 0 |
| Israel annual sweetclover | 1.5 | 1.0 | 0 |
| Denta sweetclover | 1.0 | 1.0 | 0 |
| Berseem clover | 3.0 | 1.0 | 0 |
| Rose clover #5 O.P. | 2.0 | 2.0 | 2 |
| Lakeland red clover | 4.0 | 1.5 | 0 |
| Ladino clover | 1.0 | 1.5 | 0 |
| Purple vetch | 1.0 | 1.0* | 100 |
| Lana woolypod vetch | 1.0 | 1.0* | 100 |
| Hungarian vetch | 1.5 | 1.0 | 48 |
| Warrior common vetch | 1.0 | 1.0 | 100 |
| Willamette common vetch | 1.5 | 1.0 | 100 |
| Madison hairy vetch | 1.0 | 1.0* | 25 |
| Penngift crown vetch | 4.0 | 3.0 | 0 |
| Eski sainfloid | 1.0 | 1.0* | 5 |
| Lindarin soybeans | 5.0 | 1.0 | 0 |
| Vernal alfalfa | 1.0 | 1.5 | 2 |
| Deer vetch | 5.0 | 3.0 | 100 |

* Exceptionally vigorous species

1/ 1= excellent
9= poor

Table 6. South Dakota Agricultural Experiment Station
1966 red clover variety yield trial.

Location: Brookings Plot size: 4 x 20 ft.
Design: Randomized block Planting date: May 1966
Method of seeding: V-belt drill Replications: 6
Soil type: Vienna loam Year: 1967

| Entry | Percent Stand 6-5-67 | Oven Dry Tons Per acre - 1967 2 cuts |
|------------------|----------------------------|--|
| Chesapeake | 28 | .89 |
| Dollard | 53 | 1.33 |
| Kenland | 42 | 1.39 |
| Lakeland | 72 | 1.71 |
| Mammoth | 52 | 1.36 |
| Midland | 52 | 1.39 |
| Pennscott | 58 | 1.43 |
| S.D. Alba Syn.-1 | 26 | .85 |
| Mean | 49 | 1.29 |
| d' (.05) | | .67 |

Table 7. 1968 Brookings Clover Test. RCB design, 2 replications of 4 x 20 ft. Seeded May 1, 1968.
Test area treated with 1 lb/A Benefin preplant.

| Entry | Percent | | Dates Harvested | | Oven Dry Tons per Acre | | |
|----------------------------------|---------|---------|-----------------|---------|------------------------|--------|-------|
| | Stand | 6-18-68 | cut #1 | cut #2 | cut #1 | cut #2 | Total |
| | | | | | | | |
| Dollard red clover F.C. 39, 394 | 97 | | 8- 2-68 | 8-27-68 | 1.28 | .90 | 2.18 |
| S.D. Exp. Alba clover | 90 | | 8- 1-68 | 8-26-68 | .50 | .26 | .76 |
| Lakeland red clover F.C. 39, 395 | 98 | | 8- 2-68 | 8-27-68 | 1.38 | .82 | 2.20 |
| Merit white clover F.C. 39, 719 | 97 | | 8- 2-68 | 8-26-68 | .78 | 1.00 | 1.78 |
| Ladino white clover F.C. 39, 727 | 99 | | 8- 2-68 | 8-27-68 | .68 | .98 | 1.66 |
| Idaho alsike clover F.C. 38, 922 | 95 | | 8- 1-68 | 8-27-68 | .80 | .44 | 1.24 |
| Kura clover F.C. 39, 742 | 10 | | 8-26-68 | - - - - | .22 | .00 | .22 |
| Large Hop clover F.C. 39, 642 | 94 | | 8-24-68 | - - - - | 1.18 | .00 | 1.18 |
| N.Z. Small Hop F.C. 39, 540 | 87 | | 8-23-68 | - - - - | .80 | .00 | .80 |
| Wilton Rose clover F.C. 39, 560 | 96 | | 8- 1-68 | - - - - | 1.94 | .00 | 1.94 |
| S.D. Exp. Brookings Rose clover | 93 | | 8- 1-68 | - - - - | 1.84 | .00 | 1.84 |
| Zig Zag clover F.C. 39, 743 | 45 | | 8-24-68 | - - - - | .76 | .00 | .76 |
| Bacchus marsh subt. F.C. 39, 583 | 97 | | 8-23-68 | - - - - | 2.87 | .00 | 2.87 |
| Mt. Barker subt. F.C. 39, 584 | 98 | | 8-23-68 | - - - - | 2.68 | .00 | 2.68 |
| Mississippi subt. F.C. 39, 557 | 97 | | 8-23-68 | - - - - | 1.60 | .00 | 1.60 |
| Means | 86 | | | | | | 1.59 |
| w(0.05) | 15 | | | | | | .95 |
| C.V. (%) | 4 | | | | | | 1.1 |

TEXAS

Forage Legume Research at the Beaumont Center

J. P. Craigmiles and J. R. Wood (Beaumont)

The Gulf Coast rice belt produces lush pastures during cool seasons with clovers reaching peak production in early spring. At maturity, the native annual clovers, primarily Persian (T. resupinatum), desiccate and die, while white clover is frequently productive throughout the summer, especially when adequate moisture is available.

With continued emphasis on forage quality, clover continues to maintain a prominent place in the pasture program. However, bloat is a big problem that needs to be reconciled. This report summarizes two 3-year studies previously unreported.

White Clover Evaluation

Five varieties of white clover have been seeded in separate yield tests each fall since 1963. The tests have been maintained, and clippings have been made each of the years following to evaluate summer survival and productivity. Results, summarized in Table 1, show that Regal and La. S-1 have been the most persistent and the heaviest forage producers, although Nolan and Tillman performed almost as well. There does not appear to be any agronomic advantage in using the giant types. On the contrary, the re-seeding ability of intermediate types insures a stand in case adverse weather conditions or diseases destroy the parent clones. Regal clover does not grow off as fast in the Gulf Coast prairie as does La. S-1, which may be a handicap for Regal when grown in combination with ryegrass.

Clover Compatibility Studies

Abon Persian clover (T. resupinatum), Michelianum clover (T. michelianum), Ball clover (T. nigrescens), Berseem clover (T. alexandrinum), Gulf ryegrass, and Moregrain oats were seeded alone and in all possible combinations to determine the compatibility and the most desirable species or combination of species of winter annuals for grazing. Three years' results, 1964-67, summarized in table 2, show Abon Persian clover to be the most productive clover, although ryegrass was the most productive single species tested. The most productive combination was ryegrass and Abon clover followed by oats, ryegrass, and Abon. With every species or combination tested, the addition of ryegrass increased total forage production. Ryegrass extends the grazing season, provides better

animal footing in wet weather, and provides protection in case low temperatures kill the clover and small grain. Temperatures below 20 F killed berseem and damaged Abon and La. S-1.

TABLE 1. WHITE CLOVER VARIETIES
Three-year Average of 10 Experiments, 1964-67, Beaumont, Texas

| Variety | Pounds Dry Matter per Acre by Clipping Dates | | | | | |
|---------|--|------|------|------|------|-------|
| | Feb. | Mar. | Apr. | June | July | Total |
| Ladino | 390 | 1005 | 2010 | 1315 | 1105 | 5815 |
| Tillman | 650 | 980 | 2310 | 1110 | 1118 | 6168 |
| La. S-1 | 728 | 1790 | 2380 | 1120 | 600 | 6628 |
| Nolans | 804 | 1690 | 2290 | 1190 | 710 | 6584 |
| Regal | 220 | 1140 | 2110 | 2205 | 1005 | 6685 |

TABLE 2. THREE-YEAR AVERAGE FORAGE YIELD FROM
OATS, RYEGRASS AND CLOVER COMPATABILITY STUDIES
Beaumont 1965-1967

| Forage | Pounds Dry Matter per Acre by Clipping Dates | | | | |
|--------------------------|--|-------|-------|-----|-------|
| | Jan. | March | April | May | Total |
| Gulf Ryegrass | 1431 | 466 | 1158 | 706 | 3761 |
| Berseem Clover | 311 | 352 | 1473 | 644 | 2780 |
| Ball Clover | 301 | 366 | 1431 | 458 | 2556 |
| Michelianum Clover | 296 | 469 | 1534 | 546 | 2745 |
| Abon Clover | 366 | 411 | 1411 | 868 | 3056 |
| Ryegrass & Berseem | 1620 | 526 | 1161 | 606 | 3912 |
| Ryegrass & Ball | 1639 | 517 | 1063 | 664 | 3883 |
| Ryegrass & Michelianum | 1566 | 527 | 1245 | 625 | 3963 |
| Ryegrass & Abon | 1527 | 987 | 1481 | 723 | 4718 |
| Ryegrass | 1431 | 466 | 1158 | 706 | 3761 |
| Oats, Ryegrass & Berseem | 2135 | 375 | 778 | 518 | 3806 |
| Oats, Ryegrass & Ball | 1953 | 328 | 749 | 584 | 3614 |
| Oats, Ryegrass & Mike | 1851 | 312 | 772 | 563 | 3498 |
| Oats, Ryegrass & Abon | 2179 | 414 | 798 | 947 | 4338 |
| Oats & Berseem | 1788 | 418 | 614 | 284 | 3104 |
| Oats & Ball | 1501 | 483 | 604 | 306 | 2894 |
| Oats & Michelianum | 1717 | 495 | 802 | 421 | 3435 |
| Oats & Abon | 1863 | 455 | 765 | 859 | 3942 |
| Oats & Ryegrass | 2110 | 344 | 661 | 503 | 3618 |
| Oats | 1740 | 448 | 648 | 265 | 3101 |

VIRGINIA

In Vitro Study with Birdsfoot Trefoil

John D. Miller (Blacksburg)

Clones and progeny were evaluated by the Tilley and Terry in vitro test. Duplicate samples of 20 clones were analyzed on two dates. Digestibility ranged from about 40 to 72%, but differences among clones were not significant in one test and differed at the 5 to 10% level in the second test. Variation from sample to sample was high in many cases.

Crosses of six clones from this group were studied by means of the diallel procedure. Two plants each from the 15 possible single crosses were analyzed in duplicate for each of three harvests. Six replications were evaluated for the first harvest, but only three of the second and third harvests were studied since differences between crosses were not significant for any harvest. Differences were found between harvests. The technique does not appear very useful in a plant breeding program due to the variability from sample to sample, which appears to obscure differences between crosses.

WISCONSIN

Genetics and Breeding Red Clover

R. R. Smith (Madison)

Breeding for Persistence and Disease Resistance.

Selection for persistence and disease resistance has been continued in mass selected populations described in the Newsletter for 1968. In 1968, the emphasis for disease resistance has been for northern anthracnose and bean yellow mosaic virus.

Red Clover Strain Trials, 1968.

Seventeen varieties and experimental strains of red clover were established in 5 x 30 ft. plots in 1967 at the Arlington, Lancaster, and Spooner Agricultural Experiment Stations. Seed sources and some observational data for these strains at Arlington are presented in table 1. Yields for the first harvest year are presented in table 2.

Table 1. Seed sources and some observational data for red clover strains grown on the Arlington Agr. Exp. Sta. Farm from 1966-1968.

| Strain | Seed source | Bloom <u>a/</u> | | Stand <u>a/</u> | | Plants flowering <u>a/</u> 9-30-68 |
|------------------------------------|------------------------|-----------------|-------------|-----------------|-------------|--|
| | | 6-17-68 | 7-29-68 | 5-15-68 | 9-30-68 | |
| Experiment 6701 (Established 5-67) | | | | | | |
| Lakeland | Wisconsin Breeders | 100 (65) | 100 (15) | 100 (84) | 100 (89) | 100 (32) |
| Dolland | F.C. 39,394 | 58 | 33 | 93 | 95 | 62 |
| Kenland | F.C. 39,377 | 108 | 270 | 87 | 58 | 156 |
| Orbit | F.C. 38,909 | 120 | 270 | 60 | 32 | 188 |
| Alaskland | F.C. 38,084 | 15 | - | 31 | 76 | 31 |
| Chesapeake | F.C. 39,378 | 111 | 270 | 116 | 56 | 150 |
| Pennscott | F.C. 39,393 | 105 | 300 | 108 | 83 | 162 |
| LaSalle | F.C. 38,311 | 49 | 33 | 24 | 41 | 56 |
| Tensas | F.C. 39,382 | 123 | 400 | 60 | 24 | 188 |
| Ill. 1 | Illinois (C.N. Hittle) | 105 | 200 | 103 | 88 | 119 |
| Ill. 2 | " (C.N. Hittle) | 105 | 200 | 100 | 98 | 125 |
| Syn E | Wis. Synthetic | 62 | 68 | 109 | 86 | 32 |
| Syn F | " " | 85 | 35 | 110 | 114 | 62 |
| Syn G | " " | 111 | 35 | 103 | 110 | 56 |
| Syn H | " " | 62 | 35 | 116 | 125 | 62 |
| Syn K | " " | 49 | 35 | 112 | 122 | 47 |
| Wis. Com F | Farmers source | 111 | 400 | 92 | 92 | 181 |
| Wis. Com C | Commercial source | 95 | 400 | 106 | 100 | 172 |

a/ Presented as percent of Lakeland. Absolute values for Lakeland presented in parentheses.

Table 2. Yields (Tons DM/A) of red clover strains grown on the Arlington, Lancaster, and Spooner Agricultural Experiment Stations in 1968. Established in 1967.

| Strain ^{a/} | Arlington (Exp. 6701) | | | Lancaster (Exp. 6703) | | | Spooners (Exp. 6705) | | | State avg. |
|----------------------|--------------------------|------|---------------------|--------------------------|------|---------------------|-------------------------|------|---------------------|---------------|
| | 6/17 | 7/30 | Total ^{b/} | 6/21 | 8/9 | Total ^{b/} | 7/11 | 9/10 | Total ^{c/} | |
| | | | | | | | | | | |
| Syn H | 2.32 | 1.12 | 3.44a | -- | -- | -- | -- | -- | -- | -- |
| Ill. 2 | 1.98 | 1.37 | 3.35ab | 2.84 | 1.90 | 4.74ab | -- | -- | -- | 4.04 |
| Wis. Com. C | 2.05 | 1.29 | 3.34ab | 2.57 | 1.96 | 4.53abc | 2.14 | 1.38 | 3.52 | 3.80 |
| Wis. Com. F | 1.98 | 1.34 | 3.32ab | 2.69 | 1.92 | 4.61abc | 2.28 | 1.20 | 3.48 | 3.80 |
| Syn E | 2.14 | 1.17 | 3.31ab | 2.81 | 1.73 | 4.54abc | 2.02 | 1.38 | 3.40 | 3.75 |
| Syn F | 2.09 | 1.11 | 3.20ab | 2.53 | 1.80 | 4.33 bc | 2.40 | 1.42 | 3.82 | 3.78 |
| Syn K | 2.04 | 1.10 | 3.14ab | -- | -- | -- | -- | -- | -- | -- |
| Syn G | 2.07 | 1.03 | 3.10ab | 3.08 | 1.85 | 4.93a | 2.29 | 1.32 | 3.61 | 3.88 |
| Lakeland | 1.97 | 1.13 | 3.10ab | 2.63 | 1.60 | 4.23 cd | 2.69 | 1.41 | 4.10 | 3.81 |
| Dollard | 2.11 | .98 | 3.09ab | 2.49 | 1.67 | 4.16 cd | 2.14 | 1.42 | 3.56 | 3.60 |
| Ill. 1 | 1.84 | 1.24 | 3.07ab | 2.91 | 1.80 | 4.71ab | -- | -- | -- | 3.89 |
| Pennscott | 1.73 | 1.30 | 3.03 b | -- | -- | -- | -- | -- | -- | -- |
| Kenland | 1.49 | 1.20 | 2.69 c | 2.34 | 1.97 | 4.31 bc | 2.56 | 1.25 | 3.81 | 3.60 |
| Chesapeake | 1.40 | 1.24 | 2.64 c | -- | -- | -- | 2.40 | 1.25 | 3.65 | 3.14 |
| Orbit | 1.26 | 1.30 | 2.56 c | 2.08 | 1.71 | 3.79 d | 1.95 | 1.15 | 3.10 | 3.15 |
| LaSalle | 1.46 | .93 | 2.39 c | -- | -- | -- | -- | -- | -- | -- |
| Tensas | .78 | .98 | 1.76 c | -- | -- | -- | -- | -- | -- | -- |
| Mean | 1.80 | 1.17 | 2.97 | 2.63 | 1.81 | 4.44 | 2.29 | 1.32 | 3.61 | |
| CV (%) | 10.9 | 7.7 | 5.9 | 12.5 | 12.4 | 6.6 | 16.8 | 7.2 | 7.5 | |

^{a/} See table 1 for seed source.

^{b/} Any two means followed by the same letter are not significantly different at the 5% level.

^{c/} Not significantly different.

Four varieties, Wisconsin Common, and two experimental strains were seeded on the Ashland Agricultural Experiment Station in 5 x 30 ft. plots in 1965. Yields for three harvest years (1966, 1967, and 1968) are presented in table 3.

Table 3. Yields (Tons DM/A) of red clover strains grown on the Ashland Experiment Station in 1966, 1967, and 1968. Test seeded in May 1965.

| Strain | 1968 ^{1/} , ^{2/} | | | 1966 Total | 1967 ^{1/} Total | Avg. Total 1966, 1967, and 1968 ^{1/} |
|-----------|------------------------------------|--------|--------|---------------|-----------------------------|---|
| | 6/26 | 8/5 | Total | | | |
| Syn D | 1.36a | .70a | 2.07a | 2.64 | 3.37a | 2.69a |
| Syn C | 1.58a | .78ab | 2.36a | 2.29 | 3.36a | 2.67a |
| Lakeland | .85 b | .57 bc | 1.42 b | 2.19 | 2.95ab | 2.19 b |
| LaSalle | .94 b | .38 d | 1.32 b | 2.16 | 3.10ab | 2.19 b |
| Kenland | .78 bc | .41 cd | 1.19 b | 2.33 | 2.72 bc | 2.08 b |
| Dollard | .89 b | .36 d | 1.26 b | 2.13 | 2.76 bc | 2.05 b |
| Wis. Com. | .56 c | .32 d | .88 c | 2.25 | 2.47 c | 1.86 b |
| Mean | 1.00 | .50 | 1.50 | 2.29 | 2.96 | 2.25 |
| C.V. (%) | 11.00 | 9.2 | 6.7 | 11.2 | 6.6 | 2.6 |

^{1/} Strain means followed by the same letter are not significantly different at the 1% level.

^{2/} Data for 1968 adjusted for percent foreign matter.

Inheritance of a Male-sterile Character in Red Clover

The inheritance of a male-sterile character in red clover was investigated in the F₁, BC₁, and F₂ (sib-mated F₁'s) generation of a cross between a male-sterile plant and a related male-fertile. It appears that this character is inherited in a simple Mendelian manner--male-sterility recessive to male-fertility. Male-sterility is expressed as shrunken, non-dehiscent pollen sacs containing small, non-staining pollen grains.

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